Research Article

Prevalence and Detailed Morphological Identification of Gastrointestinal Helminths of Turkeys in Wet Markets of Dhaka City: First Detection of *Capillaria philippinensis* in Bangladesh

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Abstract | Gastrointestinal helminths threaten productive poultry farming, including turkeys, resulting in substantial economic losses. The study was carried out to assess the prevalence of gastrointestinal helminths in turkeys from different wet markets in Dhaka City, Bangladesh. A total of 50 turkey intestines (*Meleagris gallopavo*) were collected from Savar Kacha Bazar (30), Mohammadpur Kacha Bazar (15), and Agargoan Kacha Bazar (5). The collected helminths were examined under a microscope using lactophenol. The overall prevalence of gastrointestinal helminth infection was 74.0%, with *Heterakis gallinarum* infecting 62.0%, and *Capillaria philippinensis* infecting 74.0% of the turkeys. The highest prevalence of helminths was observed in Savar Kacha Bazar (76.66%), followed by Mohammadpur Kacha Bazar (73.33%), and Agargaon Kacha Bazar (60.0%). Additionally, the prevalence of mixed infections (54.1%) in turkeys was higher than that of single infections (45.94%). Of the two helminth species, *C. philippinensis* has zoonotic potential. Since turkeys are raised near human settlements, farmers, meat vendors, and consumers may face to potential risks of being infected by *C. philippinensis*. To the best of our knowledge, this is the first report on helminths in turkeys in Bangladesh. Therefore, further research with a large sample size should be conducted to investigate the presence of zoonotic helminths in turkeys in the country.

Keywords | Bangladesh, *Capillaria philippinensis, Heterakis gallinarum,* Turkey, Wet market, Zoonoses

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INTRODUCTION

Domestic birds play an important role in the national economy and socioeconomic development worldwide. Traditional backyard poultry keeping has long been a cornerstone of rural livelihoods in Bangladesh, providing a crucial source of income for small, marginal, and landless households. With the growing demand for poultry meat, driven by rising incomes, population growth, and urbanization, poultry has become a significant contributor to the country's overall meat production, accounting for 37% of the total output (Begum *et al*., 2012). The poultry sector is diverse, consisting primarily of chickens (63%), ducks (11%), turkeys (5%), geese (9%), guinea fowls (3%), and pigeons (3%) globally (Besbes, 2009). Despite its importance, the poultry industry (especially broiler and layer) in Bangladesh faces severe challenges, particularly due to the threat of Avian influenza. This situation has heightened the need for alternative protein sources to sustain the increasing demand for meat. One promising option is turkey production, which has gained attention for its adaptability to various climatic conditions and its increasing demand

worldwide (Yakubu *et al*., 2013; Ogundipe and Dafwang, 1980). Turkey meat is increasingly recognized for its gamey flavor and lower fat content, appealing to health-conscious consumers and offering a potential avenue for diversifying Bangladesh's poultry industry. Despite the significant potential of domestic turkeys (*Meleagris gallopavo*) in Bangladesh, their production remains underutilized compared to other poultry species.

Domestic turkeys are omnivores, consuming a variety of food, including ground-dwelling arthropods, amphibians, and mollusks as well as vegetables, seeds, nuts, and leaves (RanjbarBahadory *et al*., 2014). However, the health of domestic turkeys can be compromised by various factors, which are poorly understood in the context of turkey farming. Viral, bacterial, parasitic, and some non-infective agents, such as nutritional deficiencies and management problems can cause intestinal problems in turkeys (Hafez, 2011; Opara *et al*., 2014; Biu *et al*., 2016). Gastrointestinal helminths, including nematodes, trematodes, and cestodes, are a primary concern, as they can severely hamper the productivity of poultry by retarded growth rates, interfering with health (Soulsby, 1982), and putting older birds at risk of severe secondary infections (Adang *et al*., 2008). Parasitic infections can lead to a range of detrimental effects, such as inappetence, emaciation, anemia, diarrhea, and reduced egg production, ultimately decreasing the economic viability of turkey farming (Gordon, 1997). Moreover, the presence of parasites like *Heterakis gallinarum* has been linked to the transmission of *Histomonas meleagridis*, further complicating health management in turkeys. Capillaria, a nematode found in the small intestines of birds like chickens, turkeys, geese, ducks, and guinea fowl can cause weight loss, diarrhea, and substantial economic losses (Hoque *et al*., 2014). *Capillaria philippinensis* is more prevalent in the Philippines and Thailand, with cases in other regions as well. More than 1000 cases were reported in humans, with 77 resulting in death (Saichua *et al*., 2008). This species resides in small freshwater fish, and when humans eat infected fish, the larvae migrate to the intestine and then mature. Female worms lay eggs, which are excreted in feces. Contaminated feces can reinfect fish, continuing the cycle, and sometimes the eggs can hatch in the human intestine, causing hyperinfection.

Despite the implications of parasitic infections, there is a notable scarcity of research focused on turkey production in Bangladesh, particularly on the prevalence and management of gastrointestinal helminths. As turkey production has increasingly become a part of the poultry landscape in Bangladesh, it is essential to investigate helminth-related health challenges to enhance production and ensure the sustainability of turkey farming. The present study aims to estimate the prevalence of gastrointestinal helminths, providing valuable insights for local and commercial poultry farmers in Bangladesh.

MATERIALS AND METHODS

Study Area

The turkey intestines from three different markets in Dhaka city (23° 48' 39.8016" N to 90° 24' 27.3888" E), were collected, including Mohammadpur Kacha Bazar, Agargaon Bazar, and Savar Kacha Bazar. The study population consisted of domestic turkeys slaughtered at the wet market's slaughter slabs. The gastrointestinal tracts were stored in clean containers and transported to the Laboratory of Microbiology and Parasitology, Sher-e-Bangla Agricultural University, Dhaka-1207, for further studies.

Processing of Endoparasites

The gastrointestinal tracts were divided into the small intestine, caecum, and large intestine. Each part was opened longitudinally along its entire length separately, and the contents were poured into sieves before being placed in a large clean beaker with labels. The contents were then gently scraped under the running tap water. All adult helminths were separated and collected in vials. The recovered helminths were rinsed with normal saline and analyzed under a light microscope. The worms were categorized, counted, and then preserved in plastic bottles containing 70% alcohol, following the method by Permin and Hansen (1998).

Morphological Identification

For nematodes, the specimens were cleared rather than stained and examined for identification under a light microscope using lactophenol. The photographs of various body parts were taken to assist in identification. Nematode identification was done based on the morphological features using the keys and descriptions of Soulsby (1982).

Statistical Analysis

The collected data were organized in Microsoft Excel, and statistical analysis was conducted using the Chi-square ($\chi 2$) test (Minitab 17 software, Minitab Ltd, UK). A difference was considered significant if it was $p<0.05$.

RESULTS

After examining 50 intestinal samples, two nematodes, *Heterakis gallinarum,* and *Capillaria philippinensis,* were identified based on their morphological characteristics under a light microscope.

Morphological Observations

***Heterakis gallinarum*:** All adult worms were found in the large intestine. They were small, white, and had three distinct lips (Figure 1A), typical of the order Ascaridida. The esophagus featured a short, narrow anterior portion,

and the head had a slight curvature, resulting in a well-developed bulb with a valvular structure (Figure 1D), features typical of the Heterakidae family. Female worms were generally larger than males, with a tapered tail (Figure 1E) and, had an anal opening at the posterior end. The vulva was located in the middle of the body (Figure 1F), and the vagina bent in three directions: angled posteriorly, anteriorly, and posteriorly again.The male had a tapering stylet-like tail with two unequal spicules at the posterior end (Figure 1B), but no gubernaculum was present. A round, well-developed pre-anal sucker was also observed, which was surrounded by a chitinized ring. The eggs within the uterus were ellipsoidal, featuring a thick, smooth shell enclosing a single cell (Figure 1C). These morphological features resemble to those of the genus *Heterakis* and the species *H. gallinarum*.

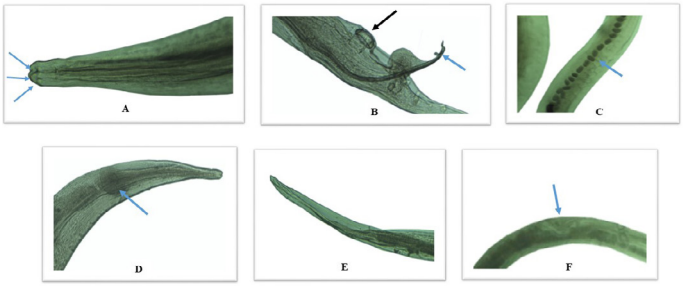

Figure 1: Different body parts of *H. gallinarum*; **A:** Anterior part of the parasite; the blue arrow indicates three well-defined lips (10X); **B:** Posterior part of the male; the black arrow shows the pre-cloacal sucker and the blue arrow indicate the spicule (10X); **C:** Multiple eggs in the uterus of female (10X); **D:** The blue arrow indicates bulb-shaped esophagus (10X); **E:** Posterior part of female (10X); **F:** The blue line indicates the vulvar opening of the female (10X).

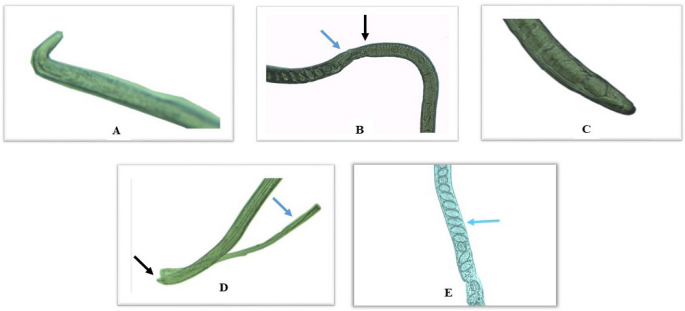

Figure 2: Different body parts of *C. philippinensis*; **A:** Anterior part of *C. philippinensis* (10X); **B:** The blue arrow indicates the vulva of the female worm, and the black line indicates the esophagus. **C.** Posterior part of female (10X); **D:** Posterior part of male; the blue arrow indicates long sheath and the black arrow indicates chitinous spicule (10X); **E:** Multiple eggs in the uterus of female (10X).

***Capillaria philippinensis*:** All adult worms were found in the small intestine. They were slender, long, skinny, and filamentous, with males generally being shorter than females.The oval eggs were characteristic bipolar plugs and had a peanut shape when unembryonated (Figure 2E), which is typical of the Order Enoplida. The body consisted of an anterior section with the esophagus and esophageal gland (Figure 2A), and a posterior section containing the intestine and reproductive system (Figure 2C). The female's vulva was located just behind the esophagus (Figure 2B), which are the common features of the Capillariidae family. Males had a single spicule with a long, unspined sheath (Figure 2D), while the anterior end was pointed (Figure 2A) and the posterior end was blunt and wider. These features align with the genus Capillaria and the species *C. philippinensis*.

Overall Prevalence

The study was conducted on 50 gastrointestinal tracts of turkeys from different markets of Dhaka city. Among them, 37 (74.0%) were found to be infected with two types of nematodes. The identified nematodes included *Heterakis gallinarum* (62.0%) in the large intestine and *Capillaria philippinensis* (74.0%) in the small intestine (Table 1).

Table 1: Species-wise prevalence of helminths in turkey.

Helminth species	No. of infected turkey	Prevalence %	Location	p-value
H. gallinarum	31	62.0	Large intestine	0.198
C. philippinensis	37	74.0	Small intestine	

The highest prevalence of *H. gallinarum* was found in Mohammadpur Kacha Bazar (73.33%), followed by Agargaon Kacha Bazar (60.0%), and Savar Kacha Bazar (56.66%). Additionally, *C. philippinensis,* had the highest prevalence in Savar Kacha Bazar (76.66%), while it was lower in Agargaon Bazar (60.0%) (Table 2).

Table 2: Prevalence of helminths from different areas of dhaka city.

Location	No. of infected samples	Prevalence (%)	Helminth species	Prevalence (%)	p-value
Savar KachaBazar (n=30)	23	76.66%	*H. gallinarum* (17) *C. philippinensis* (23)	56.66% 76.66%	0.732
Mohammadpur KachaBazar (n=15)	11	73.33%	*H. gallinarum* (11) *C. philippinensis* (11)	73.33% 73.33%	
Agargaon KachaBazar (n=5)	3	60.0%	*H. gallinarum* (3) *C. philippinensis* (3)	60.0% 60.0%	

Out of the 50 turkeys, 17 turkeys were infected with a single species of nematode (45.94%), while the remaining 20 turkeys were infected with both species of nematodes (54.10%) (Table 3).

Table 3: Prevalence of single and multiple types of infection.

Type of infections	No. of infected turkey	Prevalence (%)	p-value
Single infection	17	45.94%	0.534
Mixed infection	20	54.10%	

DISCUSSION

As far as we know, this is the first study documenting gastrointestinal helminths in domestic turkeys in Dhaka City, Bangladesh. The samples were collected from three distinct market locations in Dhaka, namely Mohammadpur Kacha Bazar, Agargaon Kacha Bazar, and Savar Kacha Bazar. These turkeys were transported to Dhaka from different parts of Bangladesh, including Gazipur, Manikganj, Faridpur, Mymensingh, Rajshahi, Gaibandha, Rangpur, Kushtia, Meherpur, and other districts. Therefore, the samples represent turkeys across the country. This study found that 74.0% of the turkeys were heavily infected with gastrointestinal helminths. Similar studies have been conducted by earlier researchers in different parts of the world. This study is similar to RanjbarBahadory *et al.* (2014), who reported 75.0% infections in Amol City, Iran, and Dauda *et al.* (2016), who recorded 68.25% nematode infections in Bukuru Jos, Plateau State, Nigeria. However, this study reports a higher prevalence than that of Opara *et al.* (2014), who documented the prevalence of nematode in 60.0% of turkeys from Southeastern Nigeria. However, Biu *et al.* (2016) recorded 60.0% nematodes in Northeastern Nigeria, and Udoh *et al.* (2014) recorded a lower prevalence (57.7%) in Kadua metropolis, Northern Nigeria. This difference and the high prevalence observed in this study could be attributed to the factors such as sampling size, geographical locations, poor hygiene, and inadequate biosecurity measures. Many turkey farmers neglect to maintain cleanliness in their poultry shelters and surrounding areas, which makes the birds vulnerable to severe infections, including gastrointestinal parasites (Yakubu *et al.*, 2013).

After examining the gastrointestinal tracts of turkeys, two types of nematodes were identified with high prevalence, including *Heterakis gallinarum* (62.0%) and *Capillaria philippinensis* (74.0%). RanjbarBahadory *et al.* (2014) recovered *Capillaria* spp. (20.0%), *A. galli* (51.0%), *R. tetragona* (8.0%), *R. echinobothrida* (8.0%), and *Echinostoma* spp (11.0%) from turkeys in Amol City, Iran. This study recorded a higher prevalence of *Heterakis gallinarum* (62.0%) in turkeys in Dhaka City, Bangladesh. Udoh *et al.* (2014) and El-Dakhly *et al.* (2012) documented a lower prevalence of 1.0% and 0.41% of *H. gallinarum* infection in Kaduna State, Nigeria, and Beni-Suef province, Egypt, respectively. On the other hand, the prevalence of *Capillaria philippinensis* in this study was 74.0% which was lower than the findings of Pinto *et al.* (2004), who reported 82.5% *Capillaria* spp. in turkey from Brazil. On the contrary, Udoh *et al.* (2014) and El-Dakhly *et al.* (2012) reported a lower prevalence of 0.5% and 0.27% *Capillaria* spp. in Kaduna State, Nigeria and Egypt, respectively. Moreover, RanjbarBahadory *et al.* (2014) reported 20.0% *Capillaria* spp. infection in turkey in Iran. These differences might be due to climate and environmental changes in the area that promote the development of the parasites. The foraging habit, the management systems, and the poor sanitary system can all contribute to the spread of infections. Many backyard farmers neglect to clean their gutters and surroundings, which increases the risk of infection for the birds. Turkeys are opportunistic omnivores, consuming a wide variety of both animal and vegetable matter. Moreover, earthworms can serve as paratenic hosts for juvenile parasites, enabling them to transport from the soil to the bird's digestive tract. *Heterakis gallinarum* eggs can remain infective in the soil for up to four years, posing a significant risk of transmitting blackhead disease if birds graze in areas contaminated with feces. When turkeys ingest infected *H. gallinarum* eggs, they can acquire *H. meleagridis*, leading to blackhead disease, which primarily affects the liver and cecum. This disease causes lesions and ulcers that can ultimately be fatal (Olsen, 1986; Kaufmann et al., 2011). Capillariasis is a parasitic disease caused by *C. philippinensis* in humans. Various species of freshwater fish are susceptible to infection and serve as intermediate hosts. This disease was first reported in the Philippines before spreading to Thailand (Saichua *et al.*, 2008), Japan (Hong and Cross, 2005), Iran (Hoghooghi-Rad *et al.*, 1987), Egypt (Ahmed *et al.*, 1999), and Taiwan (Bair *et al.*, 2004), with major outbreaks have occurred in the Philippines and Thailand (Saichua *et al.*, 2008). Intestinal capillariasis in humans leads to symptoms such as intermittent or persistent diarrhea, resulting in weight loss, abdominal discomfort, rumbling sounds in the abdomen (borborygmi), muscle wasting, general weakness, and swelling (edema). Without treatment, the condition can progress to severe muscle loss, extreme body wasting (cachexia), pronounced edema, and eventually death (Cross, 1992). *Capillaria philippinensis* prefers to inhabit the small intestines, and the infection rate was as high as 74.0% in this study.

Yoriyo *et al.* (2008), and Ohaeri and Okwum, (2013) reported that nematode parasites are more prevalent in turkeys than cestodes in general. A key finding in this study was the total absence of trematodes and cestodes in the gastrointestinal tracts of domestic turkeys. This might be due to the complex life cycle of these worms or related to

the birds' feeding habits, the availability of infective stages, and the intermediate hosts of the parasites they ingest. Unlike cestodes, nematodes are mainly transmitted through soil and do not rely on intermediate hosts. Their eggs can stay viable for an extended period of time, allowing turkeys to continuously ingest infective eggs from contaminated droppings while feeding, thus increasing their parasite load (Permin and Hansen, 1998; Ohaeri and Okwum, 2013).

Mixed infections involving two or more species of helminths were commonly observed in this study. The prevalence of mixed infections (54.10%) was higher than that of single infections (45.94%). This finding is in disagreement with Dauda *et al.* (2016) and Amer *et al.* (2024), who reported a higher prevalence of single infection in turkeys. This outcome might be due to the turkeys' food preferences at certain times, which can influence the likelihood of mixed or single infections. The ability of one or more parasites to persist within the same host contributes to the elevated prevalence of mixed infections (Fatihu *et al.*, 1991).

CONCLUSIONS AND RECOMMENDATIONS

Poultry, especially turkeys, are highly susceptible to diseases caused by parasitic pathogens, which significantly impact their health and productivity, resulting in substantial economic losses. The study detected only two nematode species, *Heterakis gallinarum* and *Capillaria philippinensis*. Among the identified nematodes, *Capillaria philippinensis* was noted for its public health significance. Farmers can easily be affected by this disease while raising turkeys. Therefore, effective control and management strategies are essential to minimize infection rates and improve overall flock health. Implementing proper biosecurity measures and deworming programs can help to enhance turkey production in Bangladesh.

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NOVELTY STATEMENT

This research has reported *Capillaria philippinensis* for the first time in Bangladesh.

AUTHOR'S CONTRIBUTIONS

Nusrat Jahan Nipu: Data collection, sample collection, methodology, writing the manuscript; Al Wasef: Data analysis, sample collection, methodology, reviewing and editing the manuscript; Nitol Chandra Das: Data analysis, sample collection, methodology; Vijay Kumar Sah: Sample collection, methodology; Md Rubel Islam: Data analysis, methodology; Md Nooralam Islam: Data analysis, methodology; Uday Kumar Mohanta: Conceptualization, supervision, reviewing and editing the manuscript. All the authors have read and approved the final version of this manuscript.

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Conflict of Interest

The authors declare that there is no conflict of interest in this publication.

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