PREVALENCE AND BURDEN OF GASTROINTESTINAL PARASITES OF GAME BIRDS IN DHAKA AND CUMILLA CITY, BANGLADESH

A Thesis

By

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*This is to certify that the thesis entitled "***PREVALENCE AND BURDEN OF GASTROINTESTINAL PARASITES OF GAME BIRDS IN DHAKA AND CUMILLA CITY, BANGLADESH***" submitted to the Faculty of Animal Science & Veterinary Medicine, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of Master of Science in Parasitology, embodies the result of a piece of bona fide research work carried out by Muhammad Saiful Bashar, Registration No. 20-11116 under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that any help or source of information, received during the course of this investigation has been duly acknowledged.

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Dedicated to
My Beloved Parents

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ACRONYMS AND ABBREVIATIONS

ABBREVIATION		FULL MEANING
Cm	=	Centimeter
Mm	=	Millimeter
Mc	=	Metacercariae
CONT'D	=	Continued
Dr.	=	Doctor
e.g.	=	For example
etc.	=	Et cetera
et al.	=	And others/Associates
HCl	=	Hydrochloric acid
hrs.	=	Hours
i.e.	=	That is
M.S.	=	Master of Science
N	=	Sample number
NO.	=	Number
sp.	=	Single species
spp.	=	Plural species
X	=	Times (Magnification)

LIST OF SYMBOLS

SYMBOLS		FULL MEANING
+	=	Plus
±	=	Plus or minus
<	=	Less than
>	=	Greater than
%	=	Percentage
&	=	And

ABSTRACT

The gastro-intestinal parasites have always been a problem causing severe parasitism in game birds where the herds are kept in small-range of area. This present study was carried out to investigate the gastro intestinal parasites in game birds in Dhaka and Cumilla city of Bangladesh. The samples were examined by routine coproscopical methods for the presence of different parasites and oocysts. The overall prevalence of intestinal parasitic infection was 42% in Bangladesh. These were documented different gastrointestinal parasites viz, *Ascaridia galli*, *Heterakis gallinarum, Capillaria* sp., *Balantidium coli, Eimeria* spp., *Giardia* sp. in Bangladesh. The highest intestinal parasitic infection (60%) was observed in the fecal sample collected from Mirpur and Cumilla, followed by Shatfeet (40%), Katabon (28%) and Mohammadpur (20%) whereas, *Ascaridia galli* (25%) *Heterakis* spp. (8%), *Capillaria* spp. (8%), *Balantidium coli* (7%), *Eimeria* spp. (8%) and *Giardia* spp. (2%) were observed. In this investigation, the prevalence of *Ascaridia galli* was highest in pigeon (38.71%) followed by parrot (33.33%), dove (30.77%), quail (25.00%), cockatoo (14.28%), guinea fowl (14.28%) and budgerigar (13.33%) respectively. The prevalence of *Heterakis gallinarum* was 16.13%, 15.38% and 14.28% in pigeon, dove and cockatoo respectively. The prevalence of single infection (23%) was higher than the multiple infection (19%) of helminthes. Alongside, the prevalence of helminthic infection (29.0%) was found relatively higher than protozoan infection (24.0%). Therefore, the necessary steps should be undertaken to control the parasitic infection of pet birds.

Key words: Gastro-intestinal, parasitic, game birds, prevalence, Bangladesh

CHAPTER 1

INTRODUCTION

There are 27 natural Orders and 8600 Families representing 30,000 species of bird in the world. Among them, there are 20 orders and 75 families representing 1200 species of birds in Bangladesh (Ali, 2003). Game birds are the best companion of human which are commonly found in houses, markets, zoo all over the world (Altman *et al*., 1997). Birds can be great source of recreation for senior citizens, children or pet less households, and they can provide companionship and enjoyment for many years. Birds are an integral part of ecosystem for maintaining ecological balance. Recently, farmers and ranchers have shown increased interest in rearing game bird for aesthetic, recreational and economic reasons. Game bird rearing is quite popular in Japan, HongKong, Korea, China, Singapore, India, Thailand, Malaysia, Indonesia, France, Italy, Germany, Britain, Russia and in many other countries. In Bangladesh, bird rearing has been increasing since 1990. Game birds which are mainly reared in urban area of Bangladesh includes pigeon, Love Birds, Parrot, Parakeet, Conure, Spotted Dove, Budgerigar, Quail, Teeter, Cockatoo and so on (Ashraful Kabir, 2019).

Although parasites usually cause little distress to healthy wild individuals, parasitic infections are considered one of the most common sanitary problems affecting game birds, especially in high-density populations (Barnes 1986). Due to an increased risk of exposure, parasites can lead to detrimental problems or even to death in birds, recently brought into captivity which were kept for prolonged periods in confined housings, and stressed by injuries, illnesses, or adaptation to new environments (Krone and Cooper, 2002; Lacina and Bird 2000; Smith 1993). The birds pick up the parasite eggs directly from surrounding by ingesting contaminated feed, water, litter and other insects which carry the eggs of the parasites (Gary and Richard, 2012). These parasites in the gastrointestinal tract lead to loss of appetite, emaciation, diarrhea, anaemia, reduced egg production, retarded growth therefore reducing their economic value. Parasitic infections have caused considerable number of death to wild life in the world every year (Patel, 2000).

Parasites that commonly invade the gastrointestinal tract of the game birds namely protozoa, nematodes, acanthocephala, cestodes and trematodes (Soulsby, 1982). As

we know, most of the game birds are imported and exported every year from neighboring country India. Some report revealed that *Ascaridia* sp., *Capillaria* sp., *Trichostrongylus* sp., *Spiruroid* sp., *Heterakis* sp. of captive birds in Gujrat, India (Parsani *et al*., 2001; Patel *et al*., 2000). Game birds were found positive for GI parasites in Punjab, Pakistan where the predominant parasites were *Eimeria* spp. followed by *Ascaridia* spp., *Capillaria* spp., *Hymenolepis* spp., *Cryptosporidium* spp., *Entamoeba* spp. and *Balantidium* spp. (Akram *et al*., 2019). Coprologic analysis revealed out that the overall prevalence of intestinal parasitic infection was 45%, among which *Ascaridia galli* was 21.67%, *Balantidium coli* was 10% and *Eimeria* spp was 13.33% in Dhaka city (Hasan *et al*., 2018). So far, where only preliminary data were included, but we will study detail morphology eggs and potential zoonosis.

Among all parasites of birds, *Hymenolepis* spp., *Cryptosporidium* spp., *Giardia* spp., *Balantidium* spp. has their possible involvement in public health (Fayer 2010; Joachim 2004; Filippich, 1998; Erlandsen, 1991). So far, 3 species namely, *C. meleagridis, C. baylei*, and *C. galli* have been considered as possible agents of avian cryptosporidiosis with zoonotic importance. Cryptosporidiosis is transmitted in human by inhalation of aerosolized droplets via respiratory secretions, by coughing, swimming pool, contaminated drinking water along with fecal–oral transmission (Sponseller *et al.,* 2014). Pulmonary infections also have been reported (Reina *et al*., 2016; Sponseller *et al.,* 2014; Fayer *et al*., 1997, 2000). Both, *Giardia ardeae* and *Giardia psittaci* are recognized as etiologic agents of avian giardiasis worldwide (Filippich, 1998; Erlandsen,1991), where *Giardia duodenalis* is responsible for infection of humans and other mammals (Feng and Xiao, 2011). The giardiasis causes diarrhea, bloating, abdominal pain, nausea, vomiting, as well as anorexia wherein chronic cases constipation, “Microscopic duodenal inflammation” in human (Hanevik *et al.*, 2007; Morken *et al*., 2008).

Some game birds parasites have zoonotic potential, and direct or indirect contact with infected specimens can cause human diseases (Corrêa and Corrêa 1992). The probability of zoonotic disease transmission is influenced by many factors, such as time of infection, latent period, stability of the agent when exposed to the environment, population density, animal handling, virulence, and route of infection (Corrêa and Corrêa 1992; Freitas *et al*., 2002). Due to the risk of human exposure to

zoonotic agents found in birds, the pet owners and ranchers have more chances to get infection from lovable game birds, if the birds are not dewormed. So, the special attention should be paid to control the parasitic infection.

As it is important to identify and control parasite species capable of producing diseases in captive birds, there is a clear need for parasitological studies on avian species like game birds. These data will be useful for establishing countermeasures needed to control these infections among the pet birds as well as human.

The present work has been taken into consideration to

- To identify the parasites through egg morphology
- To figure out the prevalence of helminthes parasites in game birds
- To observe the zoonotic intestinal helminthes in the outbreak area.

CHAPTER 2

REVIEW OF LITERATURE

Game bird rearing is quite popular in Japan, HongKong, Korea, China, Singapore, India, Thailand, Malaysia, Indonesia, France, Italy, Germany, Britain, Russia and inmany other countries. Bird rearing has been increasing since 1990 in Bangladesh.

Hasan *et al*., (2018) showed that game birds are silent controller of maintaining ecological balance. A total of 60 birds (budgerigar, parrot, cockatoo, dove, turkey and teeter) were collected from several places of Dhaka Municipality area. Coprologic study revealed that the overall prevalence of intestinal parasitic infection was 45%, of which 21.67% of *Ascaridia galli*, 10% for *Balantidium coli* and 13.33% for *Eimeria* spp. The prevalence of *Ascaridia galli* was 28.7%, 22.22% and 16.6% in teeter, budgerigar and parrot respectively. *Eimeria* spp. (16.67%) in budgerigar. The prevalence of *Ascaridia galli* was highest (25%) followed by *Eimeria spp* (16.67%) in parrot. The prevalence of *Ascaridia galli* in cockatoo was 16.67%. In dove prevalence of *Balantidium coli* (44.44%) was highest followed by *Ascaridia galli* (22.22%). The prevalence of *Eimeria* spp. and *Balantidium coli* were highest (25%) followed by *Ascaridia galli* (12.50%) in turkey. The prevalence of *Ascaridia galli* was highest (28.57%) followed by *Eimeria spp* (14.23%) in teeter.

Mondal and Manna, (2019) reported that theis study was carried out to investigate the gastro-intestinal parasites in captive birds at Alipore Zoological Garden, Kolkata, West Bengal, India. Out of total 392 faecal samples collected, 176 (44.89% prevalence) were found to be positive for helminthic and protozoan parasites. The present study documented 9 different gastrointestinal parasites viz, *Capillaria* sp. (11.73%); *Ascaridia* sp. (32.90%); *Heterakis* sp. (9.69%); *Hymenolepis* sp. (1.02%); *Eimeria columbae* (1.27%); *E. mayurai* (1.78%); *E. labbeana* (3.06%); *E. pavonis* (1.78%); *Isospora mayuri* (1.02%), from different captive birds of this zoological garden. Among helminth infections, 119 (30.35%) faecal samples were found to have mono infection with one species of helminthes and 57 (14.54%) samples show multiple infection. The enteric protozoan infections were lesser in magnitude (2.80%) when compared to helminth infections.

Hembram *et al*., 2015 showed that the overall, 58.75% birds were found infected with various gastrointestinal helminths. Total five species of parasites were detected that included *Ascaridia galli* (25.63%), *Heterakis gallinarum* (33.75%), *Raillietina tetragona* (46.25%), *Raillietina echinobothrida* (11.87%), and *Echinostoma revolutum* (1.87%). Both single (19.15%) as well as mixed (80.85%) infection were observed in Odisha in India.

Parsani *et al*., (2001) revealed out that a total of 28 group faecal samples of different captive birds at Sakkarbagh Zoo, Junagadh, Gujrat were examined cage wise. Among them, 20 (71.43%) were found positive for parasitic infections. Eggs of *Ascaridia* sp. and *Capillaria* sp. were found in nine (69.23%) and five (38.46%) group faecal samples respectively; oocyst of coccidia (*Eimeria* sp.) in 10 (50%); ova of trematode in five (25%) and cestode segment in one (0.50%) group faecal samples were observed.

Akram *et al*., (2019) documented that this survey was conducted to investigate the point prevalence of gastrointestinal (GI) parasites of captive birds in Pakistan. 613 fecal samples from captive birds belonging to 19 species were examined from Gujranwala and Jhang districts by using direct and indirect methods under the microscope. Protozoa, nematodes, cestodes and trematodes contributed 69.33%, 35.39%, 6.61% and 0%, respectively, where the overall prevalence of 54.32%. The predominant parasite species were *Eimeria* (67.87%), followed by *Ascaridia* (33.93%), *Capillaria* (11.41%) and *Hymenolepsis* (6.61%). Age and rearing systems of birds were considered as risk factors for GI parasites. Adult captive birds were more commonly infected (58.05%) than yearlings (37.27%). The captive birds reared in aviaries had a higher prevalence of infection (83.51%) than cage-birds (49.23%).

Ilić *et al*., (2018) investigated that the presence of endoparasites was established in 51.96% (Belgrade), 46.16% (Palić) and 16.66% (Bor) of the tested birds in Serbia. They diagnosed coccidian oocysts, eggs of *Capillaria* spp., *Heterakis* spp., *Trichostrongylus* spp., *Ascaridia* spp., *Syngamus trachea* and yet unidentified trematode eggs. There were no detection of eggs of cestodes. Prevalence of infection with coccidia, depending on location, was in the ranges between 8.33% and 32.84%, capillariosis 2.77% and 29.41%, heterakiosis2.56% and 12.74%, trichostrongylidosis

5.55% and 25.64%, askaridiosis 10.25% and 10.78%, syngamosis 2.94% and trematodes of unknown etiology 2.45%.

Khan et al., (2010) showed that 67.70% were found positive for single or mixed infection of *Heterakis gallinae* (73.86%) and *Ascardia galli* (26.14%) in parrots at Lahore Zoo, Pakistan.

Papini *et.al*., (2012) recorded that overall, 35.6% of the birds harboured parasites (42.2% of zoo birds and 27% of pet birds), including Strongyles-Capillarids (8.9%), *Ascaridia* (6.8%), Strongyles (5.5%), *G. duodenalis* (5.3%), Coccidia (4.1%), *Cryptosporidium* (4%), *Porrocaecum* (2.7%), *Porrocaecum*-Capillarids (2%), and *Syngamus*-Capillarids (0.7%). The zoonotic *G. duodenalis* and *Cryptosporidium* were exclusively found in Psittaciformes, with prevalences of 10.3% and 7.7% within this bird group. Clinicians should be aware of the public health implications posed by zoonotic *G. duodenalis* and *Cryptosporidium* species in captive birds.

Laku *et al*., (2018) reported that fifty domesticated pigeons (*Columba livia*) were purchased from Trans-Amadi abattoir, Port Harcourt, Nigeria for the investigation of the ecto-parasites and intestinal helminths. Two ecto-parasites were observed from the pigeon. Three intestinal helminths were recovered namely, *Raillietina tetragona*, *Ascaridia columbae* and *Eimeria* sp. where the prevalence rates were 38%, 6% and 2% respectively.

CHAPTER 3

MATERIALS AND METHODS

3.1. Sampling area

The present study will be conducted to find out the prevalence of different gastrointestinal parasites infection in game birds. In this study, the fecal samples of Pigeon, budgerigar, love birds, quail, conure, parrot, parakeet, spotted dove, cockatoo and teeter will be collected from several pet bird markets such as Mirpur, Kataban, Mohammadpur, Shatfeet and Cumilla areas to identify the parasitic egg in game birds. These are selected due to having many pet birds shop on that location.

3.2. Selection of birds

A total of 100 pooled fecal sample of birds will be selected randomly in which Pigeon (n=31), Budgerigar (n=15), Love birds (n=11), Dove (n=13), Cockatoo (n=7), Parrot (n=12), Guinea fowl (n=7) and Quail (n=4). The ages of game birds will be determined according to Akinboye *et al*. (2017) based on the size of crown, length of the spur and flexibility of xiphoid cartilage together along with the information from the owner.

A. **B.**

Figure 1: A+B. Different species of birds displayed at birds shop

3.3. Fecal sample collection and preservation

The fecal sample of game birds will be collected freshly early in the morning during opening of pet shops. Before collection of sample, all possible safety and hygienic measures will be taken to avoid contamination. The bird's owner use metallic tray for each cage and wash tray every day. Thus, it is possible to avoid soil and other contamination during sample collection. During sample collection, all relevant information will be taken from the owner such as species, age, number of birds in each cage, deworming status, rearing system and feeding habit. Then, about 5-10 grams of feces from each cage will be collected using separate plastic spoons in separate plastic vials and a few drops of 70% ethanol will be added to each sample. The vials will be labeled properly and then transferred to the laboratory to preserve the sample.

C.

Figure 2: C. Preservation in screw cap vial for further investigation.

3.4. Coprological examination

The fecal samples will be examined by direct smear method and simple sedimentation technique for detection of parasitic eggs, cysts or oocysts in the Laboratory of Microbiology and Parasitology under the Faculty of Animal Science and Veterinary Medicine in Sher-e-Bangla Agricultural University, Dhaka-1207.

3.4.1. Direct Smear Method: A small amount 1.0gm feces will be taken on clean, grease free slide with the help of tooth pick, and a thin smear will be produced after adding few drops of water. Then the coarse particle will be removed towards the end

of slide. A suitable coverslip will be put over the smear, and slide will be then placed under low power objectives of a microscope for examination.

D.

Figure 3: D. Performing direct smear method

3.4.2. Sedimentation Method: 3.0gm feces will be taken into a sterile glass container and containing water. The fecal sample will be mixed thoroughly and allowed to sediment for 20-30 minutes. Then it will be passed through a sieve into another glass cylinder and allowed to stand for half an hour to form a clear sediment. This procedure will be repeated three times to get clear sedimentation. Then, the supernatant fluid will be carefully poured off, a small amount of sediment will be taken with a medicinal dropper on a clear slide. After that coverslip will be placed on the slide and examined under a light microscope.

E. F.

Figure 4: E. Properly stirring of fecal sample, **F.** Sedimentation for drop down the eggs

3.5. Morphological identification of egg of parasites

The sample will be processed for microscopic examination in the laboratory. The ova, cysts and oocysts of different parasites will be tentatively identified according to the morphology, and then quantitative estimation will be done by applying the McMaster technique to determine egg per gram (EPG), cyst per gram (CPG) and oocyst per gram (OPG) of faeces as described by Soulsby, (1982).

3.6. Statistical analyses

The data comprised locations (Katabon, Mirpur, Mohammadpur, Shatfeet and Cumilla), bird species, parasite species and infection nature (single and mixed) were considered independent variables. Data for low detection rates were excluded from the analyses. Pearson's chi-square and Fisher's exact test were used to assess the association of parasite detection rates in different study locations, species of the birds and parasite, and nature of infection in GraphPad Prism 8 (GraphPad Software, San Diego, CA, USA). A p value considered significant when it was <0.05.

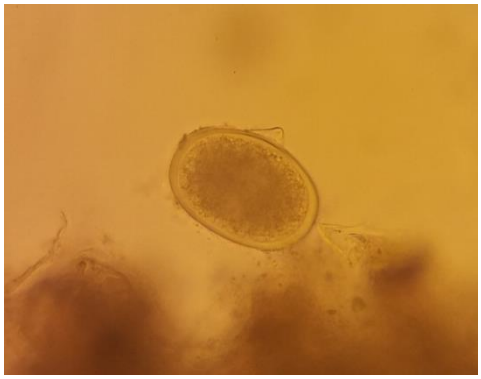
CHAPTER 4

RESULTS AND DISSCUSSION

RESULTS

Through examination of 100 different fecal sample from different types of game birds (Pigeon, Budgerigar, Love birds, Dove, Cockatoo, Parrot, Guinea fowl and Quail), many different parasites were recovered. The endoparasites includes three species of nematodes (*Ascaridia galli*, *Heterakis* spp., *Capillaria* spp.) and three species of enteric protozoa (*Balantidium coli*, *Eimeria* spp. and *Giardia* spp.).

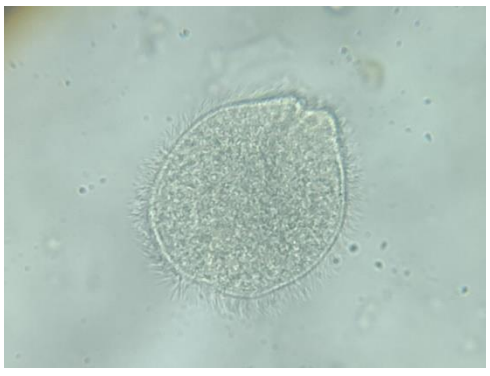
4.1. Morphological observation



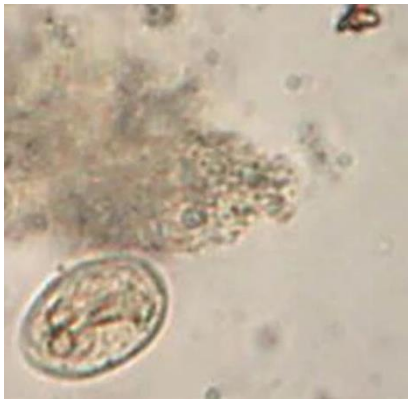
A. *Ascaridia galli* (4x)

B. *Heterakis gallinarum* (4x)

C. *Capillaria* spp. (10x)



D. *Balantidium coli*. (10x)



E. *Eimeria* spp. (10x) **F.** *Giardia* spp. (10x)

Figure 5: Morphology of different eggs of different birds A. *Ascaridia galli* **B.** *Heterakis gallinarum* **C.** *Capillaria* spp. **D.** *Balantidium coli* **E.** *Eimeria* spp. **F.** *Giardia* spp.

A. *Ascaridia galli*: Golden brown colored eggs of Ascaridia have thick shell and covered with corrugated albuminous coat. The eggs are roughly spherical in shape and contain an unsegmented cell and a mass of granules.

B. *Heterakis gallinarum*: Eggs are ovoid thick and smooth shelled with almost parallel side walls. Unsegmented when laid

C. *Capillaria* spp.: Eggs are light brown, thick walled with two shells, straight sided with bipolar plug. Eggs are unembryonated.

D. *Balantidium* spp.: Ciliated protozoa with a large, ovoid trophozoite 40-70 µm long, covered with cilia; contains both macronucleus and micronucleus.

E. *Eimeria* spp.: Oocysts were broadly pear shaped to ovoid. They had thickened & smooth wall around. They were yellow to light brown in color.

F. *Giardia* spp.: Fully matured cyst is oval or ellipsoidal shaped which is surrounded by a thick wall. A cyst conain 4 nuclei (Soulsby, 1982).

4.2. Prevalence

The study was carried out in a total of 100 pooled fecal sample of game birds such as Pigeon (n=31), Budgerigar (n=15), Love birds (n=11), Dove (n=13), Cockatoo (n=7), Parrot (n=12), Guinea fowl (n=7) and Quail (n=4) were examined through coprological test. Among them, 42 (42%) pooled game birds were infected with intestinal parasites. On the basis of morphological features, six intestinal parasites species were identified namely, *Ascaridia galli*, *Heterakis spp*., *Capillaria spp*., *Balantidium coli*, *Eimeria* spp. and *Giardia* spp. The highest intestinal parasitic infection (60%) was observed in the birds fecal sample collected from Mirpur and Cumilla, followed by Shatfeet (40%), Katabon (28%) and Mohammadpur (20%) in Table 1. In the fecal sample examination, mainly the ova of nematodes namely *Ascaridia galli* (25%) *Heterakis* spp. (8%), *Capillaria* spp. (8%) were observed. On the other hand, the coccidian namely, *Balantidium coli* (7%), *Eimeria* spp. (8%) and *Giardia* spp. (2%) were observed. In this investigation, the prevalence of *Ascaridia galli* was 38.71%, 13.33%, 30.77%, 33.33%, 14.28%, 14.28% and 25.00% in pigeon, budgerigar, dove, parrot, cockatoo, guinea fowl and quail respectively. The prevalence of *Heterakis gallinarum* was 16.13%, 15.38% and 14.28% in pigeon, dove and cockatoo respectively. The prevalence of *Capillaria* spp. was 19.35%, 7.69% and 14.28% in pigeon, dove and guinea fowl respectively. On the other hand, the prevalence of *Eimeria* spp. were 6.67%, 23.08%, 8.33% and 42.86% in budgerigar, dove, parrot and cockatoo respectively. Then, the prevalence of *Balantidium coli* was 3.23%, 6.67%, 15.38%, 8.33%, 9.09% and 14.28% in pigeon, budgerigar, dove, parrot, love birds and guinea fowl respectively whereas, the prevalence of *Giardia* spp. were 3.23% and 14.29% in pigeon and cockatoo. In this study, 23% birds were infected with single species of helminths where as 19% were infected with multiple species of helminthes.

4.2.1. Overall prevalence

In this study, a total of 100 fecal sample of pooled game birds were examined in where 42 sample were infected with intestinal parasites.

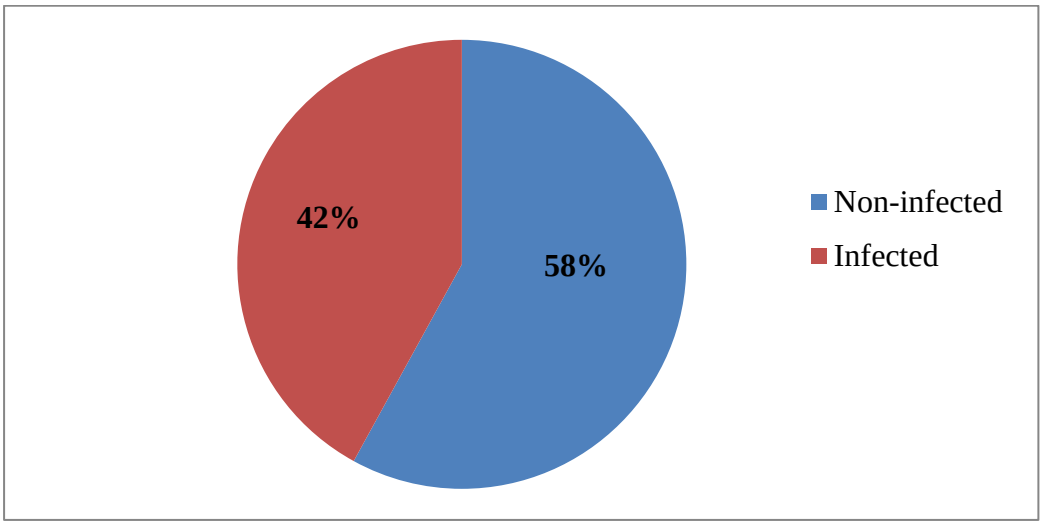


Figure 6: Overall prevalence of intestinal parasites in game birds.

4.2.2. Area wise prevalence

The highest intestinal parasitic infection (60%) was observed fecal sample collected from Mirpur and Cumilla, followed by Shatfeet (40%), Katabon (28%) and Mohammadpur (20%).

Location	**No. of sample examined**	**No. of positive sample**	**Prevalence (%)**	***p*-value**
Katabon	25	7	28	
Mirpur	25	15	60	
Mohammadpur	20	4	20	
Shatfeet	10	4	40	0.0174
Cumilla	20	12	60	
Total	100	42	42	

Table 1: Area wise prevalence of intestinal parasites in Dhaka city Corporation area

4.2.3. Prevalence of single and mixed type infection

Examined pooled fecal samples of game birds were infected with one or mixed species of helminth parasites. Among the 100 fecal sample, 23 were infected with single species of parasites (23%) and rest 19 were infected with multiple species of parasites (19%).

Table 2: Prevalence of single and mixed type infection in game birds

Types of infection	**No. of infected sample**	**Percentage**	***p*-value**
Single infection	23	23%	0.6029
Mixed infection	19	19%	

4.2.4. Prevalence of helminths and enteric protozoa

Types of infection	**No. of infected sample**	**Percentage**	***p*-value**
Helminths infection	29	29%	0.5218
Protozoan infection	24	24%	

Table 3: Prevalence of enteric helminthes and protozoa in fecal sample of game birds

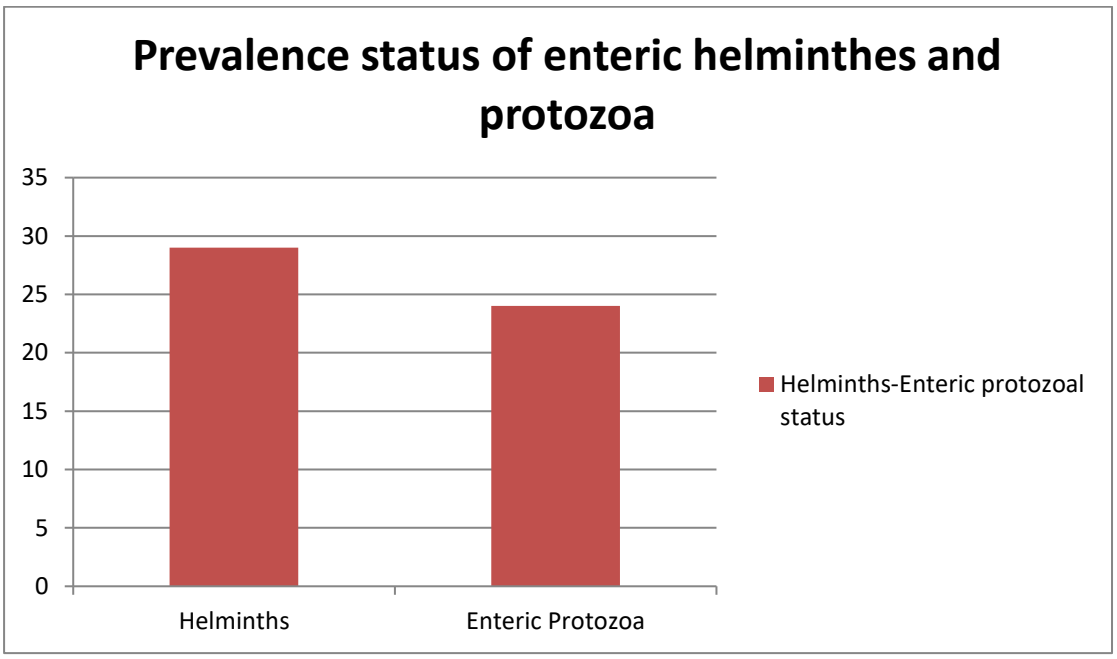


Figure 7: Prevalence of enteric helminthes and protozoa in game birds

4.2.5. Overall prevalence of intestinal parasites in game birds in Bangladesh

Types of birds	No. of sample examined	No. of positive sample (%)						Total infected (%)
		Ascaridia galli	*Heterakis gallinarum*	*Capillaria* spp.	*Eimeria* spp.	*Balantidium coli*	*Giardia* spp.	
Pigeon	31	12(38.71)	5(16.13)	6(19.35)	-	1(3.23)	1(3.23)	80.65*
Budgerigar	15	2(13.33)	-	-	1(6.67)	1(6.67)	-	26.67*
Dove	13	4(30.77)	2(15.38)	1(7.69)	3(23.08)	2(15.38)	-	92.30*
Parrot	12	4(33.33)	-	-	1(8.33)	1(8.33)	-	50.00*
Love birds	11	-	-	-	-	1(9.09)	-	9.09*
Cockatoo	7	1(14.28)	1(14.28)	-	3(42.86)	-	1(14.29)	85.71*
Guinea fowl	7	1(14.28)	-	1(14.28)	-	1(14.28)	-	42.84*
Quail	4	1(25.00)	-	-	-	-	-	25.00*
Total	100	25 *	8 *	8 *	8 *	7 *	2 *	

**P<0.0001*

DISCUSSION

Game birds are becoming popular day by day, that is commonly found in households, markets and zoos all over the country. In present study, all the collected pooled fecal samples collected from different game birds species in Bangladesh. The present study gives the overview on the intestinal parastic infection of game birds in Bangladesh. Six species of endoparasites were reported where three species were nematode namely, *Ascaridia galli*, *Heterakis* spp., *Capillaria* spp. and three species enteric protozoa namely, *Balantidium coli*, *Eimeria* spp. and *Giardia* spp.

In this study, it was revealed that 42.0% of the faceal samples were infected with GI parasites. This result is similar to the earlier report from Bangladesh Hasan *et al*. (2018) reported 45.0% prevalence where game birds were found to be infected with *Ascaridia galli*, *Balantidium coli* and *Eimeria* spp. On the other hand, this present study documented six parasites species namely, *Ascaridia galli*, *Heterakis* spp., *Capillaria* spp., *Balantidium coli*, *Eimeria* spp. and *Giardia* spp.

The prevalence in this study is similar to the prevalence of Akram *et al*. (2019) from Pakistan, Mandal and Manna, (2019) from Alipore Zoological Garden, Kalkata, India, Fecchio *et al*. (2017) from Florida, Akinboye *et al*. (2017) from North America, where game birds were infected with 54.32%, 44.89%, 40.6% and 38.0% of intestinal parasites respectively. On the contrary, prevalence of present investigation was lower than the previous report of Hembram *et al*. (2015) in Odisha, India (58.75%); Albers, (2014) in Java, Indonesia (72.0%); Khan *et al*., (2010) in Pakistan (67.70%); Parsani *et al*., (2001) in Gujrat, India (71.43%). The observed differences was might be due to variation in different geographic location, climatic condition, sampling size, analytical technique, managemental conditions (feeding, watering) etc.

The previous study reported that prevalence of *Ascaridia galli* was 22.2%, 25.0%, 16.7%, 22.2%, 12.5% and 28.6% in budgerigar, parrot, cockatoo, dove, turkey and teeter, respectively but in this present study, the prevalence of *Ascaridia galli* was 38.71%, 13.33%, 30.77%, 33.33%, 14.28%, 14.28% and 25.00% in pigeon, budgerigar, dove, parrot, cockatoo, guinea fowl and quail respectively. Alongside, in previous study showed that *Balantidium coli* was 44.4%, 25.0% in dove and turkey,

respectively. The prevalence of *Balantidium coli* was 3.23%, 6.67%, 15.38%, 8.33%, 9.09% and 14.28% in pigeon, budgerigar, dove, parrot, love birds and guinea fowl respectively in this present investigation. *Eimeria* spp. was 16.7%, 16.7%, 25.0%, 14.2% in budgerigar, parrot, turkey and teeter, respectively in previous study but in this case, *Eimeria* spp. were 6.67%, 23.08%, 8.33% and 42.86% in budgerigar, dove, parrot and cockatoo respectively. The salient difference in the current findings versus the previous reports is the high percentage of *Ascaridia galli* in different birds due the number of sample collected as well as pooled sample. The number of parasitic species is also higher than the previous study.

Mandal and Manna, (2019) documented 9 different gastrointestinal parasites viz, *Capillaria* sp. (11.73%); *Ascaridia* sp. (32.90%); *Heterakis* sp. (9.69%); *Hymenolepis* sp. (1.02%); *Eimeria columbae* (1.27%); *E. mayurai* (1.78%); *E. labbeana* (3.06%); *E. pavonis* (1.78%); *Isospora mayuri* (1.02%), from different captive birds of zoological garden, Alipore, Kalkata, India. Akram *et al*. (2019) investigated four predominant parasite species were in the genera *Eimeria* (67.87%), followed by *Ascaridia* (33.93%), *Capillaria* (11.41%) and *Hymenolepsis* (6.61%). Fecchio *et al*., (2017) documented three species of parasites namely, *Ascaridia galli* (43%), *Balantidium coli* (28%), and *Eimeria* spp. (12%) in love birds in Florida. Khan *et al*., (2010) reported *Heterakis gallinae* (73.86%) and *Ascaridia galli* (26.14%) from parrots at Lahore zoo in Pakistan. Ferrell *et al*. (2006) reported *Ascaridia galli* (16%), *Eimeria tenella* (18%), *Eimeria acervulina* (12%) and *Balantidium coli* (22%), from game birds. However, Borecka *e*t *al.*, (2013) recorded *Ascaridia galli* (34%) and *Eimeria* spp. (23%) from game birds in Poland. Dubiec and Cichon (2001) found *Ascaridia galli* (42%), *Heterakis gallinae* (13%), *Lucida sphenoides* (20%) and *Echinostoma revolutum* (6%) from love birds in Saudi Arabia. Papini *et.al*. (2012) recorded Strongyles-Capillarids (8.9%), *Ascaridia* (6.8%), Strongyles (5.5%), *G. duodenalis* (5.3%), Coccidia (4.1%), *Cryptosporidium* (4%), *Porrocaecum* (2.7%), *Porrocaecum*-Capillarids (2%), and *Syngamus*-Capillarids (0.7%) in zoo and pet birds in Italy. Laku *et al*., 2018 documented pigeon harbored three intestinal helminths namely, *Raillietina tetragona* (38%), *Ascaridia columbae* (6%) and *Eimeria* sp (2%) in Nigeria.

During the present study, the prevalence of helminthic infection (29.0%) was found higher than protozoan infection (24.0%). This result is also supported by Mandal and

Manna (2019) at Alipore Zoological garden, Kolkata; Parsani *et al.* (2001) at Sakkarbagh Zoo, Junagarh, Gujarat; Patel *et al*. (2000) in Kamala Nehru Zoo and Ahmedabad and Sayyajibaug Zoo, Vadodara, Gujarat, India; Parsani and Momin (2009) at Shri Sayaji Baug Zoo, Vadodara, India.

During this investigation 23.0% were infected with single species of parasites and rest 19.0% were infected with multiple species of parasites which is nearly similar to Mandal and Manna (2019) who reported 30.35% faecal samples were found to be infected with single species of helminths and 14.54% samples showed multiple infection. On the other hand, Hembram *et al*. (2015) recorded single infection 19.15% as well as multiple infection 80.85% in Odisha, India.

The high frequency of GI parasitism in captive birds might be due to ingestion of contaminated droppings or intermediate hosts such as cockroaches, beetles, earthworm, flies and grasshopper in poorly managed aviaries Akram *et al*. (2019).

CHAPTER 5

SUMMARY AND CONCLUSION

The study was carried out in a total of 100 pooled fecal sample of game birds. Among them, 42 (42%) pooled game birds were infected with intestinal parasites. The endoparasites includes three species of nematodes (*Ascaridia galli*, *Heterakis* spp., *Capillaria* spp.) and three species of enteric protozoa (*Balantidium coli*, *Eimeria* spp. and *Giardia* spp.). The highest intestinal parasitic infection (60%) was observed in the birds fecal sample collected from Mirpur and Cumilla, followed by Shatfeet (40%), Katabon (28%) and Mohammadpur (20%). In the fecal sample examination, mainly the ova of nematodes namely *Ascaridia galli* (25%) *Heterakis* spp. (8%), *Capillaria* spp. (8%) were observed. On the other hand, the coccidian namely *Balantidium coli* (7%), *Eimeria* spp. (8%) and *Giardia* spp. (2%) were observed. In this study, 23% birds were infected with single species of helminths where as 19% were infected with multiple species of helminthes.

Gastrointestinal parasitic infection is common in the game birds in Bangladesh. Better management practices and adequate prophylactic measures are important strategies to control gastrointestinal parasites. Further, long term epidemiological studies of parasitic infections are essential to understand infection routes and to prevent the possible recurrence of infections in game birds. Such studies will provide a clear concept to develop appropriate preventive and therapeutic measures against parasitic infection in game birds.

CHAPTER 6

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