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SUMMARY

Ascariasis caused by *Ascaridia galli* is a common parasitic infection in chicken throughout the world.This infection is prevalent in all kind of production systems and cause substantial economic problem in terms of lower feed consumption, reduced weight gain, lower egg production and even death in case of heavy infections. Information about phenotypic variation is ultimate understanding the host parasite relationship as well as to design an effective control measures against this economically important parasite. Therefore, this study was conducted to get updated information on the prevalence of *Ascaridia galli* infection in chickens. For this purpose, a total of 200 chickens' feces was collected from hilly area (Rangamati, Khagrachari and Bandarban). 21 chickens out of 200 were found positive to the infection giving the prevalence as 10.5% of *A. galli* infection in chickens of the study area, of which males were 12 (57.14%) whereas females were 9(42.85%). The result of this observation indicates that there is a marked pattern of *Ascaridia galli* infection in both sexes. From this result without significant test it is difficult to prove it proved that males are more susceptible than females. Relatively young animals were more susceptible than adult. Age group wise prevalence was as follows 57.14 % in 14 -52 wks, 33.33 % in 1.5 -2 yrs and 9.52% in 2.5-3yrs respectively. It was documented that the rate of occurrence of *A. galli* in Summer 41.15%, Rainy 44.67% and winter 14.18%. Free range housing system chickens were more infected than semi intensives housing system. Anthelmintic were used more in semi intensives than free range housing system.

Key words: *Ascaridia galli*, Hilly Chicken, Prevalence, Post mortem findings, Microscopic Examination ,Egg identification.

CHAPTER 1: INTRODUCTION

Poultry rearing is one of the most appropriate income generating activities for rural women especially for landless and marginal farmers. The production of backyard poultry under semi scavenging system is found suitable to the villagers as additional source of income and nutrient supplement (Latif, 2001). Backyard poultry is popular among rural people in Bangladesh is one of the most economically vulnerable and densely populated countries in the worldwhere>40% of the people living below the poverty line (Ferdushy et al., 2016). Poultry rearing is very common , but 50% of households with chickens have no land at all (Saha et al., 2000). However, the poultry production is hindered by many problems among which infectious diseases are most important (Ojok, 1993). In fact the indigenous chickens of hilly areas in Bangladesh are parasitized by various parasites (Sarkar, 1976). Very few studies have been undertaken so far to determine the prevalence of gastrointestinal helminth infection in indigenous chickens in Bangladesh (Rabbi et al., 2006; Ferdushy et al., 2014). Not such studies have been done in hilly region. Poultry rearing plays a vital role for the generation of income of hilly people, as this requires minimum land, little capital and relatively less skills which is suitable for the hilly people as income source. It also used as tool for poverty alleviation as well as women empowerment. Poultry meat and eggs contribute with approximate 37% of the total animal protein requirement (Prabakaran.,2003).In hilly areas in Bangladesh, chickens are reared under different condtions, such as extensive, semi intensive and free range systems. Scavenging/semi intensive systems are mainly practiced by smallholders in hilly areas, whereas intensive systems are much more organized and are largely used for commercial production (Baig et al., 2006). Hence, Chickens are found most of their feed by roaming around the households, where they eat variety of feed items like kitchen waste, leaves, grasses, insects, arthropod, earthworm, ants etc. Most of the cases, there is found that chickens are infected during early ages and the parasites may be present throughout the production due to not using antiparasitic drugs and disinfectants in production system, poultry have different parasitic infection such as *Ascaridia galli*. In spite of the vast prevalence and potential economic importance very little research has been done on the presence of GI parasite infection in deshi chicken in hilly areas of Chattogram region in Bangladesh. This paper describes the prevalence of *Ascaridia galli* infection in backyard poultry in three hilly areas in Chattogram district, Bangladesh. Hilly chicken heavily infected with *Ascaridia galli* which shows signs of diarrhea,

weight loss, economic losses etc are principally associated with mortality and reduction in feed efficiency and egg production.In addition, *Ascaridia galli* is also inferred to work as a vector of *Salmonella spp*. therefore having significant importance from a public health stand point Chadfield, M., et al., (2001), (Ramadan and Abouznada,1992) the production of backyard poultry under Semi scavenging system is found suitable to the villagers as additional source of income and nutrient supplement (Latif, 2001). Backyard poultry is popular among rural people. However, the poultry production is hindered by many problems among which infectious diseases are most important (Ojok, 1993). In fact the indigenous chickens of Bangladesh are parasitized by various parasites (Sarkar, 1976). Very few studies have been undertaken so far to determine the prevalence of gastrointestinal helminthes infection in indigenous chickens in Bangladesh (Rabbi et al., 2006; Ferdushy et al., 2014). Indigenous chickens are defined as a group of heterogeneous native fowls, which have been left to out-cross over the years in rural households and their importance for rural economy is immense in many countries of the world (Barua and Yoshimura 1997; Vali 2008; Magothe et al 2012). These chickens play a major role for the rural poor with respect to their subsidiary income and also provide them with high protein food (eggs and meat). Their potential is enormous and has not been realized because of many constraints like infectious diseases, parasitism, predation, lack of feed, housing, low genetic potential, lack of marketing policy and inadequate farmer education (Nzioka 2002). Parasitism due to GI helminths and ectoparasites constitutes among the major causes that decrease productivity of chickens, but neglected as they are rarely lethal (Permin et al 1997; 2002; Hunduma et al 2010).Studies conducted on rural free-range poultry in Botswana (Mushi et al 2000), Ghana (Poulsen et al 2000), Morocco (Hassouni and Belghyti 2006), Nigeria (Idika et al 2016), Tanzania (Permin et al 1997;) and Zimbabwe (Mukaratirwa et al 2001; Permin et al 2002) have shown high prevalence of both external and internal parasites among indigenous chickens. In Kenya, Sabuni et al (2010;) have shown that ecto and haemo-parasites are common in free range chickens and ducks. However, few such studies have been done on helminthes parasites of poultry in the country (Chege et al 2015) Scavenging free-range birds are in constant contact with soil which serves as an important reservoir and transmission site for infective larval stages of helminthes and arthropods which act as paratenic or intermediate hosts. These factors explain the presence of wide range of helminthes and their impact in the health and growth of scavenging rural chickens (Permin et al 1997; Phiri et al 2007). A study conducted in Kenya by) showed that

farmers did not deworm their indigenous chickens and were not aware about the existence of parasitism in poultry. This study was designed to investigate the prevalence and intensity of GI parasites in marketed indigenous chickens with the ultimate aim of developing control strategies relevant for free range poultry management.

Objectives of the study:

i. To know updated information on the prevalence of GI parasite infection in hilly chickens.
ii. To identify *Ascaridia galli* by post mortem in hilly chicken.
iii. To identify risk factors causing Ascaridiasis in hilly chicken.

CHAPTER 2: REVIEW OF LITERATURE

2.1: Poultry sector in Bangladesh:

The poultry sector plays an important role in maintaining agricultural growth and cut down malnutrition for the people in Bangladesh (da Silva and Rankin, 2014). It is an entire part of farming system in Bangladesh and helped to create direct, indirect employment opportunity including support services for about 6 million people (Ansarey et al., 2012).This sub sector has verified as alluring economic activity, thereabout, signifying its importance for the whole economy. The sector estimates for 14% of the total value of livestock output and is growing rapidly (Raihan and Mahmud, 2008).It is stated that in Asia, poultry meat contributes 37% of the total meat production in Bangladesh. Poultry contributes about 22-23% of the total animal protein supply in the country (Prabakaran, 2003).It is find out that, poultry manure is conducted as feed for fish where poultry are raised up top of the ponds as part of an integrated system such as, fish-cum-duck farming. Improvement of poultry has originated considerable employment through production and marketing of poultry and poultry products in Bangladesh (da Silva and Rankin, 2014).

2.2: Management systems:

There is clear link between good animal health and improved production. Diseases morbidity and mortality all conduct to loss of production which is aimed through improvements in welfare (Appleby et al., 1991). Free range refers to poultry systems in which the birds have run (4metre square\hen (Gordon and Charles, 2002). Free range chicken must not only have access to outdoor running and day light, but also have indoor housing at night. (Shimmura et al., 2010). Chickens are in appropriate free range rearing systems are considered to be healthier, having stronger immune systems and welfare improvement than in cage systems (Fanatico et al., 2006). But Ascarid infections were found in caged flocks, including common in non-cage systems (Nyman et al.,2010).Chickens kept in free range systems are bound to increased risks of come parasites (Wonggrak et al., 2014). The absence of hygiene barrier at the entrance of the house or unit increased the risk of infection which suggests that parasites eggs were sed the age of equipment (Nyman et al., 2010).

2.3: Ascaridia galli:

Nematodes, endo-parasites, belong to the phylum Nemathelminthes; class Nematodes, the most common species in poultry with cylindrical and elongated shape. All nematodes have an alimentary tract with separate sexes. The life cycle may be direct/indirect including an intermediate host (Permin and Hansen, 1998).Species with a direct life cycle are more frequent under intensive farming conditions where certain temperatures and humidity are ideal for larval development. On the other hand, species with indirect life cycles are particularly abundant in traditional farms birds kept outdoors, especially in humid and humus rich soils that are favourable for earthworm development. The characters of nematode is unique such as carbohydrate rich surface coat (Fetterer and Rhoads,1993) and moulting several times throughout their development cycle they change their antigenic and cuticular surface (Blaxter et al.,1992), (Sneath et al. 1973) which plays dominant role.

2.4: Scientific classification of *Ascaridia galli*

Kingdom: Animalia

Phylum: Nematoda

Class: Secernentea

Order: Ascaridia

Genus: *Ascardia*

Species: *A. galli*

Fig: Grossly *Ascaridia galli*

2.5: Epidemiology of *Ascaridia galli*:

Ascaridia galli is worldwide occurring parasite found in indigenous chickens as well as free range. In below there is given an overview of countries where *A. galli* has been identified. It may be observed that only few countries have reported the presence of *A. galli*. However, in reality all chickens seem to be infected, but there is lack of prevalence. The first identification of *Ascaridia galli* was made in Germany by Schrank, 1788. The findings of *A. galli* are reported in Brazil, India, The Philippines', Democratic Republic of Congo, China, Canada and UK (Ackert, 1931). In 2018, only 25% of the ~ 230M of chickens produced annually are raised in large scale 'industrial' farms in this country, with the remaining corresponding to chickens raised in the backyard and small-scale farms (Anon. 2018). Small-scale commercial farms represent an upgrade from backyard production, since flocks are confined and single-age (i.e. 'all-in-all out') and are mostly raised on commercial feed. These production systems are very much on the increase, a phenomenon going in parallel with an unprecedented increase in demand for poultry meat in the country (Anon. 2015), (Shimmura et al. 2010).

2.6: Associated risk factors:

The reason for the low prevalence recorded may be associated with the fact that the birds recruited for this study were intensively managed where they get better treatments in terms of biosecurity, hygiene, feeding, and appropriate preventive medical programs and general management etc.

2.6.1: Feeding:

Chickens fed on diets containing animal protein acquire fewer worms compared with those fed mainly on plant protein. Increasing levels of essential amino acids especially, lysine and calcium, in feed also lessens the number and length of parasite (Cuca et al., 1968). Furthermore, feed rich in vitamins A and B minimized the chances of A. galli establishment in the intestine (Walker & Farrell, 1976).

Furthermore, vitamin A and B, essential amino acids and animal origin protein should be provided to the infected birds as feed supplement. (Bachaya, H.A., Raza, M.A., Anjum, M.A., Khan, I.A., Aziz, A., Manzoor, Z. and Munawar, S.H., 2015. Prevalence of Ascaridia galli in white leghorn layers and Fayoumi-Rhode Island red crossbred flock at government poultry farm Dina, Punjab, Pakistan. *Trop. Biomed*, *32*(1), pp.11-16.)

2.6.2: General Management:

Higher helminth infections have been reported in extensively and semi-intensively raised birds compared to intensively raise domestic chickens. the expected outcome, birds raised in the deep litter had a lower prevalence of helminth infections compared to those raised in a battery cage. (Bachaya *et al*. and Teni *et al*. 2019) reported that birds raised on deep litter were more infected with helminths than those raised in a battery cage.

2.6.3: Biosecurity:

The biosecurity in poultry houses where other animals are present (e.g., dogs) will be seriously compromised. The higher risk of infection seen in birds raised in the presence of other avian species may be associated with cross infections between different bird species. Similar studies was also found (Strunz *et al*., Ikpeama *et al,* and Taiwo *et al*. 2019), higher prevalence of helminth infections with proximity to waste area and level of sanitation and hygiene.

2.6.4: Preventive medical program:

The proper use of anthelminthic drugs farmers will be benefited but frequent use of anthelmintics increases the resistant population of nematodes.(Strunz *et al*., Ikpeama *et al,* and Taiwo *et al*. 2019) have associated higher prevalence of helminth infections with proximity to waste area and level of sanitation and hygiene.

2.7: Predilection Site:

Ascaridia galli occurs worldwide in birds of all ages. The adult worms live in the lumen of the intestine, but occasionally also found in crop, gizzard and oviduct or body cavity (Ramadan and Abouznada, 1992).

2.8: Morphology of Identified Parasites:

Morphology Adult worms are yellowish white in color and semitransparent. Cuticle is distinctly striated and the cuticular alae are feebly developed (Ramadan and Abouznada, 1992). The oral opening is surrounded by three prominent trilobed lips. Two conspicuous papillae occur on the dorsal lip and one on each of the subventral lips. 12 A pair of the so-called neck papillae occurs on the sides of the body near the anterior end. (Freeborn, 1923; Schrank, 1788). *Ascaridia galli* is the most common nematode of poultry

(Ackert 1931; Katakum et al. 2010) having direct life cycle have described the detailed morphological features of *A. galli*. Van, N.T.,et al., (2020).

a. Head magnified to show bps and cephalic papillae b. Posterior end of male to show caudal papillae c. Tail to femaled. Vulvar region in female Females are longer than males with a length of 72-116 mm and a straight posterior terminal, whereas males are around 51-76 mm and possess a curved posterior terminal (Ashour, 1994). In the anterior end, both sexes have a prominent mouth with three distinct lips, bearing teeth like denticles on their edges (Hassanen et al., 2009). The entire body is covered with a thick cuticle, which is striated transversely throughout the length of the body (Permin et al., 1997). The eggs are oval and surrounded by three layers: the inner permeable layer called the vitelline membrane, a thick resistant shell and a thin albuminous layer(Fetterer et al. (Ackert et al. 1931; Hansen et al., 13 1956). These layers are a key factor for its resistance against desiccation and its long term persistence in the environment. Larvae do not hatch in the environment; instead, they moult inside the eggs until they become infective (L3).

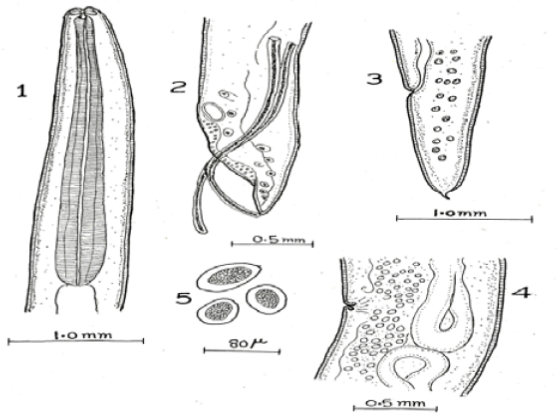


Figure 3: Camera lucida drawings of *Ascaridiagalli.* 1. Anterior end of male (ventral view); 2. Posterior end of male (lateral view); 3. Posterior end of female (lateral view); 4. Valval region of female (lateral view); 5. Eggs.

Fig: Morphology of *Ascaridia galli*

2.9: Life cycle of *Ascaridia galli*:

At optimal temperature and humidity most fertile eggs within 24 hours, start dividing into two-cell stage (Ramadan and Abouznada, 1992). In the next 24 hours, second division takes place and gives rise to the three-cell stage. The four cell stage is normally seen within three days in most of the eggs. After 3 days, a morula with blastomeres is

formed, which is completed by the end of the fifth day. After 8 days, the so called “tad pole” stage develops and after two additional days a vermiform embryo is developed. Within the next three to four days, this transforms into the coiled and fully mature infective L3 larva. (Joint et al.2001), (Ramadan and Abouznada, 1992). The whole process may take between 7 to 20 days or longer depending on the temperature and relative humidity (Permin and Hansen, 1998; Reid, 1960). The life cycle is completed when new hosts ingest the infective eggs. After ingestion, the infective eggs are mechanically transported to the proventiculus and gizzard and further down to the duodenum where they hatch within the first 24 hours. Triggering factors that signal the larvae to hatch are believed to be temperature, carbon dioxide level and pH levels (Dick et al., 1973). Following hatching, the larvae burrow into the mucosal layer of the small intestine to enter the histotrophic phase (Ackert, 1931). The duration of the histotrophic phase is 3 to 54 days before the larvae return to the intestinal lumen where they reach final maturity (Permin and Hansen, 1998). However, this period is dose dependent and probably very much related to the phenomenon of arrested development (Herd and McNaught, 1975; Ikeme, 1971a). After the histotrophic phase, the mature worms settle down in the lumen of duodenum where they live and feed on ingesta and produce huge number of eggs that are passed with the faeces into the external environment where the life cycle continues (Ramadan and Abouznada, 1992). The pre-patent period varies from 5-8 weeks (Pankavich et al., 1974; Permin and Hansen, 1998).

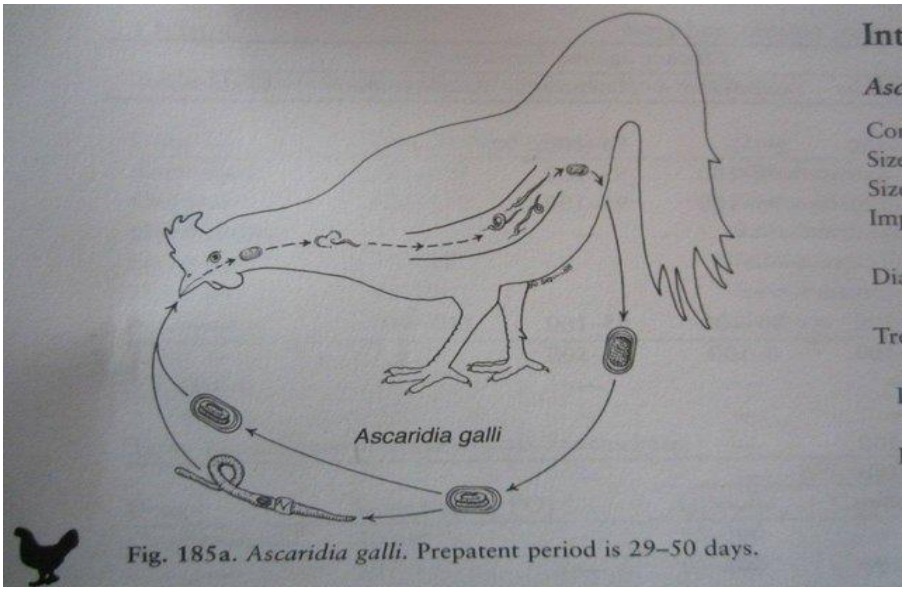


Fig: Life cycle of *Ascaridia galli*

2.10: Pathogenesis and clinical symptoms:

Young birds seem to be more susceptible to *Ascaridia galli* infection than adults and manifest greater degree of damage. Penetration of the parasite into the duodenal or jejunal mucosa may cause hemorrhagic enteritis, anemia often associated with severe diarrhea as well as loss of appetite, weakness, decrease activity, ruffled feathers and dirty cloacal region (Adang et al., 2010; Ikeme, 1971b). Established larvae in some cases cause destruction of the glandular epithelium (Permin et al., 1997). Moreover, adhesion of the mucosal villi may occur due to proliferation of secretary cells. Not only the larvae can cause pathological lesions, also adult worm can cause damage to the epithelium in the form of pressure atrophy upon villi (Ikeme, 1971b). In addition to reported pathological signs in chicken, a study reported that liver of the infected pigeons had fatty degeneration with coagulation necrosis of the hepatic cells. The authors also found necrotized tissues in the lungs, heart and kidneys of the infested birds (Adang et al., 2010). What is more, a number of studies have been carried out to investigate the effect of combined infections caused by helminthes, bacteria and virus and their effect on production parameters. Earlier studies on the effect of *A. galli* on the immune system in chickens led to further investigations studying the influence of *A. galli* on subsequent *E. coli* infections. Accordingly it was suggested that combined infections has a significant impact on weight gain and more severe pathological manifestation in group with combined infections (Permin et al., 2006). Following the same theme, the effect of *A. galli* on subsequent *Pasteurella multocida* infections was shown to be predominantly on weight gain and egg production (Dahl et al., 2002). These studies indicate that interactions between parasitic, bacterial and viral diseases exist. In addition, from welfare standpoint, it has been reported that infected birds manifested behavioral changes, for instance, infested chickens showed a higher food intake and lower activity as well as changes in ground pecking and nesting activity during the both prepatent and patent periods (Gauly et al., 2007). *A. galli* can negatively affect the table egg quality. One such case is when the adult worms is occasionally seen in the chicken`s egg. Parasite can migrate up the oviduct through cloaca and participate in the egg formation process (Höglund and Jansson, 2011; 16 Khalaf et al., 1982; Wang et al., 2016). Although presence of parasite worm in hen’s egg is not considered as hazard for public

health, it can cause potential consumer complaint. However contaminated eggs can be easily identified during candling process.

CHAPTER 3: MATERIALS AND METHODS

3.2: Study Period:

The proposed study was conducted in July 2019 to February 2020.

3.3: Study population:

A total of 200 fecal samples from the indigenous chickens were collected from different households of three hill tracts of Chattogram division of Bangladesh were examined for the presence of GI parasites in this study. The demographic information about rearing system, deworming history, clinical signs, seasonal variation, age, sex etc. were obtained from the owners using a structured questionnaire.

3.4: Collection of sample and preservation:

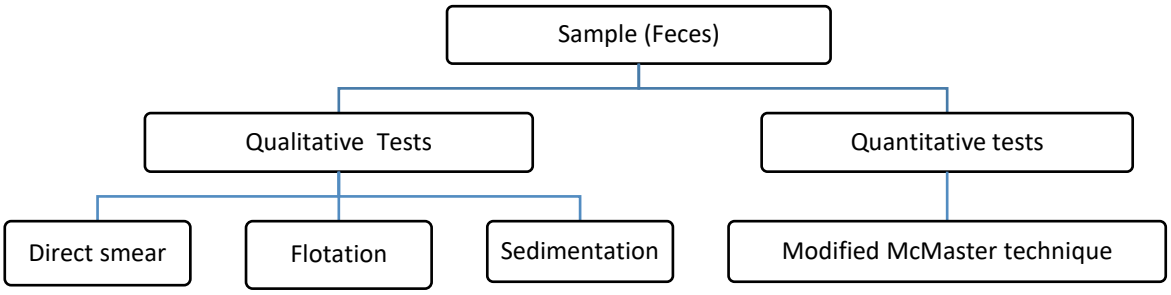
A model questionnaire was used to record the information such as age, sex, rearing system, deworming history, feeding history, housing management etc. For parasitological examination feces was collected with fecal container using hand gloves and identified well and carried by ice box within 24 hours by maintaining cool chain. Fecal sample was divided into two in separate fecal container. One was preserved in 70% ethanol for identifying parasitic eggs by direct, floatation, sedimentation methods and Stall dilution technique. Each vial was marked with unique identification number and that time basic demographic information (owner's name and address, animal ID, flock size, age, sex, weight, deworming history etc.) also collected through questionnaire. Then the samples were immediately transferred to the laboratory at the Department of Pathology and Parasitology, CVASU and refrigerated at 4 degree temperature for further examination.

3.5: Laboratory examination:

The direct smear, flotation and sedimentation methods described by Urquhart et al. (1996) were performed to screen out the positive samples. Modified McMaster Counting technique developed by Soulsby(1982) and Tibor (1999) was also carried out to determine the parasitic eggs load (epg).

3.6: Experimental design:

The study was designed according to Tibor (1999).



Experimental design for the diagnosis of *Ascaridia galli*

3.6.1. Qualitative techniques for identifying *Ascaridia galli*:

A number of different methods are available for identifying eggs from poultry droppings samples. Three methods are described:

- Direct smear.
- Simple test tube flotation.
- Sedimentation technique.

3.6.1.1. Simple test tube flotation:

Principle:

The simple test tube flotation method is a qualitative test for the detection of Ascaridia spp eggs in the faeces. It is based on the separating of eggs from faecal material and concentrating them by means of a flotation fluid with an appropriate specific gravity.

Application:

This is a good technique to use in initial surveys to establish which groups of parasites are present.

Equipment's:

- Beakers or plastic containers
- A tea strainer (preferably nylon) or double layer cheese cloth
- Measuring cylinder or other container graded by volume
- Fork, tongue blades or other type of stirring rod
- Test tube

- Test tube rack or a stand
- Microscope
- Micro slides, coverslips
- Balance or teaspoon
- Flotation fluid (see the Appendix to this handbook for formulation).

Procedure:

(a) Approximately 3 g of faeces (measured with a recalibrated teaspoon) into Container 1.

(b) 50 ml flotation fluid added into Container 1.

(c) Faeces and flotation fluid was thoroughly mixed with a stirring device (tongue blade, fork).

(d) The resulting faecal suspension was thoroughly poured a tea strainer or a double-layer of cheesecloth into Container 2.

(e) The faecal suspension was poured into a test tube from Container 2.

(f) The test tube was placed in a test tube rack or stand.

(g) Gently top up the test tube with the suspension, leaving a convex meniscus at the top of the tube and carefully place a cover slip on top of the test tube.

(h) Let the test tube stand for 20 minutes.

(i) Carefully lifted off the cover slip from the tube, together with the drop of fluid adhering to it, and immediately placed the coverslip on a microscope slide. (Urquhart G.M, et. al.), (E.J.L. Soulsby).

Fecal Egg Counts:

Individual fecal samples were collected during the slaughter process either as freshly dropped feces or from the colon. The individual fecal samples were analyzed to estimate the number of eggs per gram of feces (EPG) using a modified McMaster counting technique with a sensitivity of 50 EPG. As the eggs of A. galli and Heterakis spp. are similar in morphology to be clearly differentiated, they were counted together and are named as Ascarid eggs in the following.

3.7: Postmortem Examination:

Postmortem examination was done for dead birds. The GI tract was thoroughly examined for *Ascaridia galli*.

3.8: Statistical analysis:

The questionnaire data are transferred to Microsoft Excel and then analyzed.

Pictorial Presentation during collecting sample

Fig: Taking History

Fig: Sample Collection

Fig: Sample collection

Fig: Weighing of birds

Fig: Semi-intensive housing

Different types of Egg in Microscopic Examination

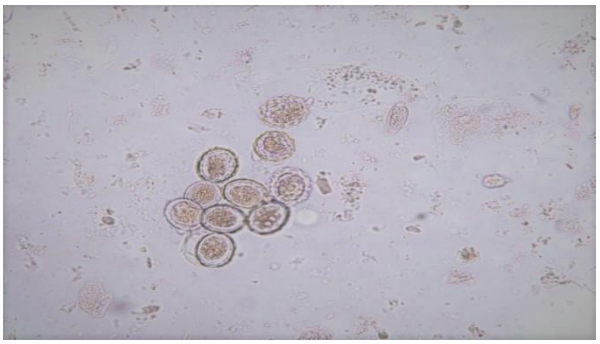


Fig: *Trichuris spp*

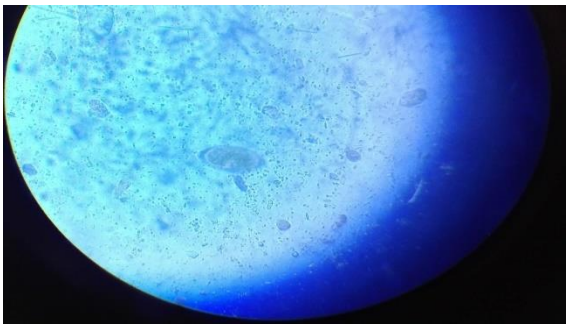


Fig*: Ascaridia galli*

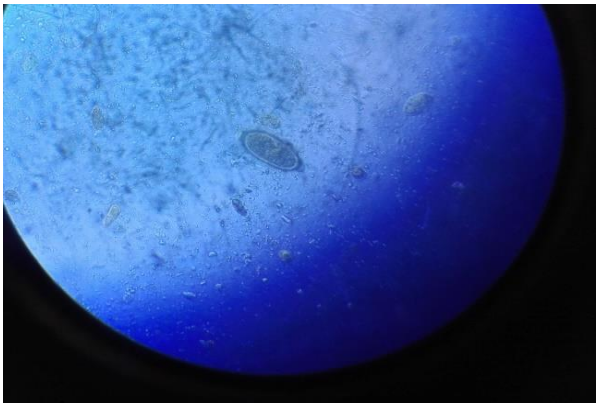


Fig: *Ascaridia galli*

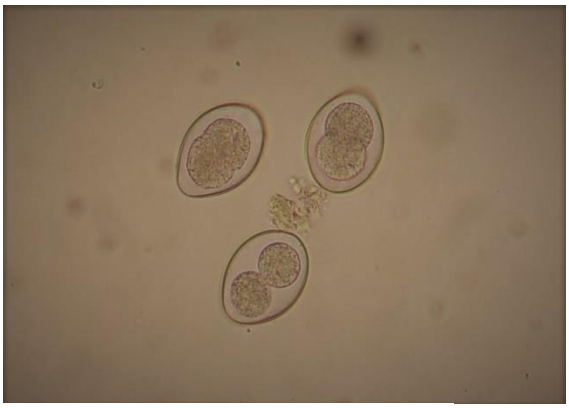


Fig: Cyst of Eimeria

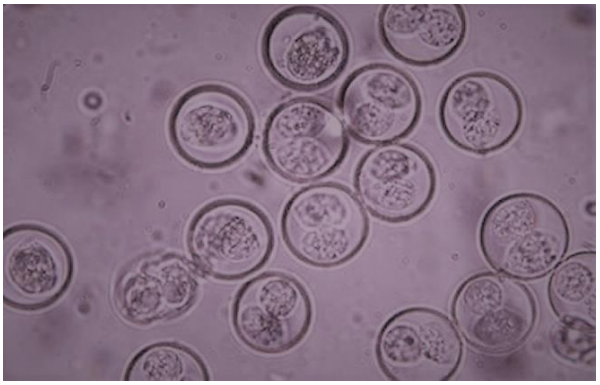


Fig: Cyst of Eimeria

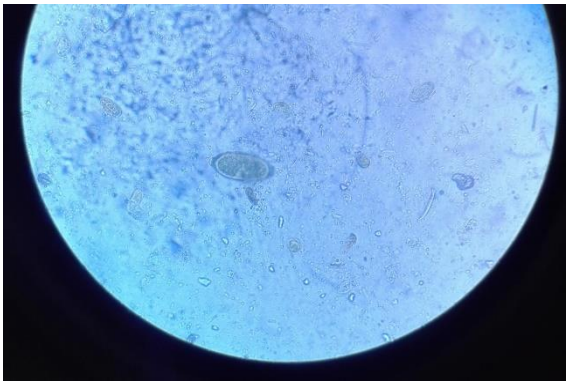


Fig: *Heterakis spp*

CHAPTER 4: RESULTS

4.1: Overall prevalence of GI parasites:

Initially by direct and flotation technique of fecal sample of poultry, helmithes were identified grossly. In this study period, we found 21 chickens were infected by *Ascaridia galli* out of 200 chickens which indicated 10.5% prevalence rate, *Heterakis gallinarum* 75% in free range system whereas 25% in semi intensive system followed *by Eimeria spp* infection rate was 85.71% and 14.29% respectively .

Species of endoparasites	Health status		Rearing systems	
	Normal No. (%)	Poor No. (%)	Free-range No. (%)	Semi-intensive No. (%)
Ascaridia galli	4 (16.5%)	17 (80.5%)	90.47%	9.53%
Heterakis gallinarum	1 (25%)	3 (75%)	75%	25%
Eimeria spp	4 (20%)	16 (80%)	85.71%	14.29%

Table 1: Prevalence of GI parasites

4.2: Prevalence of *Ascaridia galli* on the basis of rearing system:

In the study *Ascaridia galli* was sheltered in 12.67% (19 out of 150) in free range chickens and 4% (2 out of 50)in semi intensive rearing chickens. It might be indicated that birds reared in free range harbor high infection than semi intensive rearing systems.

4.3: Area wise prevalence of *Ascaridia galli:*

Area wise prevalence of hilly chickens was located in different areas of Rangamati, Khagrachari and Bandarban districts. These sample were collected from the Manikchari, Sapchari, Tole Adam, Mrou para, Noapara and Thakurchora every area have different occurrence percentage i.e 23.81%, 33.33%, 4.76%, 23.81%, 4.76% and 14.29% respectively.

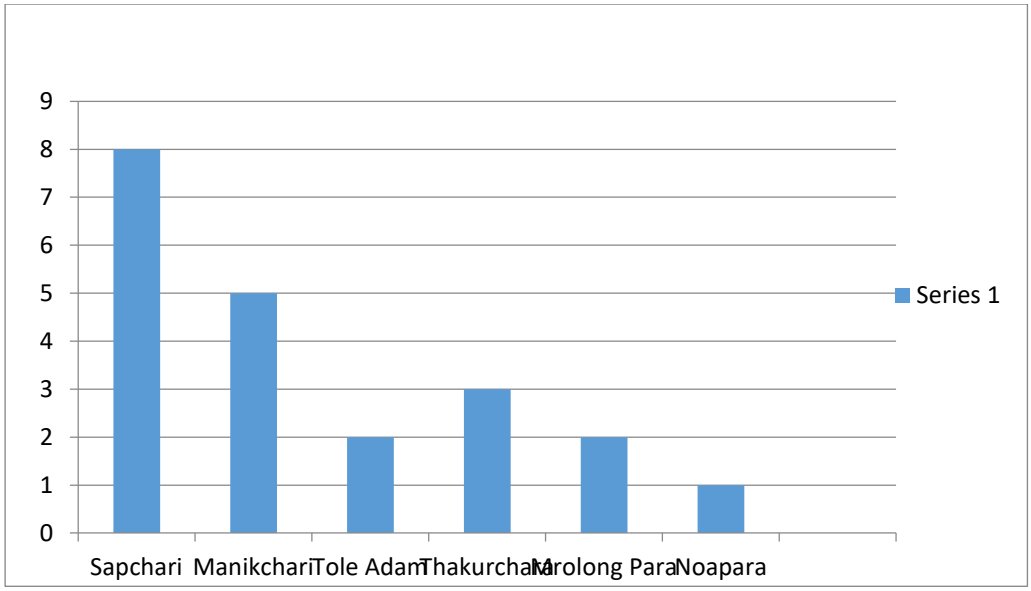


Fig: Prevalence of *Ascaridia galli*

4.4: Prevalence of *Ascaridia galli* infection on the basis of sex:

Males were more susceptible than females hilly chicken.Our study showed that out of 21 infected parasites males were 12 (57.14%) whereas females were 9 (42.85%).

Species of endoparasites	Sex	
	Male No. (%)	Female No. (%)
Ascaridia galli	12 (57.14%)	9 (42.85%)

Table 2: Prevalence of *Ascaridia galli* infection on the basis of sex

4.5: Prevalence of *Ascaridia galli* infection on the basis of age of host:

Occurrence percentage at different ages of chicken was recorded in our study. Infection rate of *Ascaridia galli* varied with different age group. The infection rate of *Ascaridia* according to age was 57.14% in 14 -52 wks, 33.33% in 1.5 -2 yrs. and 9.52% in 2.5 -3 yrs respectively.

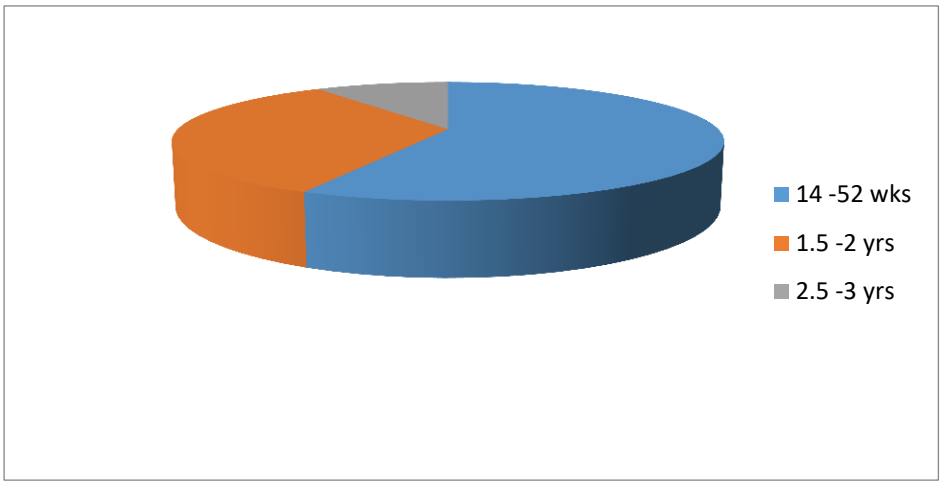


Fig: Prevalence of *Ascaridia galli* infection on the basis of age of host

4.6: Season wise Prevalence:

In relation to seasons it was documented that the rate of occurrence of *A. galli* was in Summer 41.15%, in rainy 44.67% and in winter 14.18%. The seasonal occurrence rate of *A. galli* linfectivity in hilly chickens was documented maximum throughout rainy season followed by summer and minimum during the winter weather as showed in below.

Parasite	Seasonal Prevalence		
Ascaridia galli	Summer	Rainy	Winter
Percentage (%)	41.15%	44.67%	14.18%

Table 3: Season wise Prevalence

4.7: Post Mortem Findings of *Ascaridia galli*:

Post mortem in hilly chicken, proventriculus revealed ulcerative proventriculitis characterized by superficial epithelium, sub-epithelial hemorrhages and underlying fibrosis. Secondary bacterial infection was observed in the ulcerated area. *A. galli* causes blockage of small intestine, petechial hemorrhage in the duodenum, marked inflammation and increased mucous secretion in small intestine Ikeme (1971b) reported that adult worms migrated up and down the intestinal lumen, when present in large numbers. Soulsby (1986) reported

that burrowing of parasites in the intestinal mucosa reveals inflammatory lesions and focal hemorrhages.

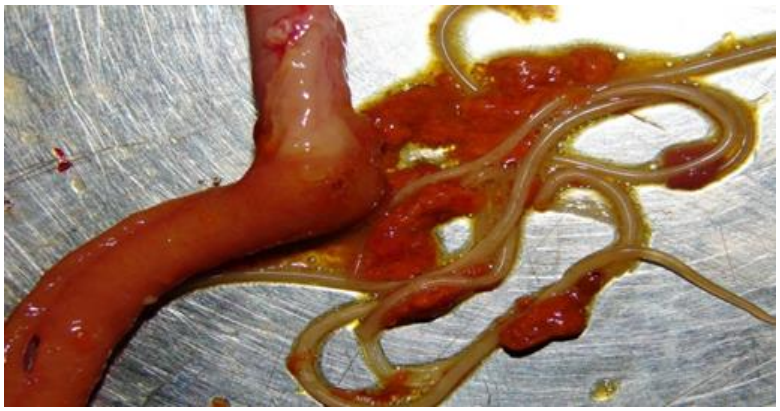


Fig: Post Mortem Findings of *Ascaridia galli*

Table-4: **Prevalence of positive case of *Ascaridia galli* by post mortem:**

Parasite	**Positive case**	**Percentage**
Ascaridia galli	2	9.52%

4.8: Egg Morphology:

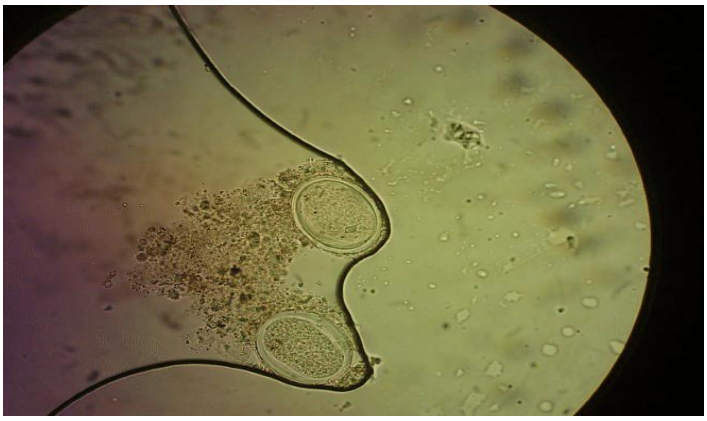


Fig: *Ascaridia galli* egg

4.9: Use of anthelmintic:

Anthelmintics were used in a total of 40/200 (20%) normal flocks. A total of 9 farmers had administered anthelminthic to their flocks over the five week period prior to slaughter, and 31 farmers had administered anthelminthic earlier. A total of seven types of anthelmintics had been used such as Levamisol (42.5% flocks), followed by Mebendazol (20.0%), Fenbendazol (17.5%), Praziquantel (15.0%), Ivermectin (7.5%), Sufadimethocine (7.5%) and Albendazol (2.5%).In this study, we observed that when chickens were dewormed they were less infected to this worm. Deworming chicken infection rate was 5% whereas non deworming chicken was 95%.

CHAPTER 5 : DISCUSSION

Ascaridia galli in chickens have been reported in several countries of investigators. The present study reveals that out of 200 hilly chickens, 21(10.5%) were infected by *Ascaridia galli*. Similar to our findings, Ayudhyinvestia and Sangvaranond (1993) reported 22% *A. galli* infection in Thailand. However, our study result states lower infection rate than other studies in Bangladesh. Rabbit et al. (2006) reported higher prevalence (87.50%) *A. galli* infection in indigenous chickens in Mymensingh district. In Narsingdi district of Bangladesh, Ferdushy et al.(2016) identified (70-85)% *A. galli* infections in chickens**.** The prevalence of *A. galli* infection was 18% observed by Danicke et al. (2009) in Germany. The range of reported prevalence of gastrointestinal helminth infections from other parts of the world varied from (20-60)% Alam et al., (2014) . The difference among the result of the present and earlier works in other countries might be due to the variation of the geographical location of the research area, method of detection and sample size.

Considering the rearing type vulnerability, our data showed that free range reared chickens were more vulnerable compared to intensive reared chickens. This concept is supported by other recent studies in Bangladesh (Ferdushy et al., 2016; Rabbit et al., 2006). Similar to our findings, Ferdushy et al. (2014) reported 84.6% (95% CI: 77.9-90.0) gastrointestinal helminth infection in Narsingdi district in Bangladesh. However, Rabbi et al. (2006) reported relatively higher prevalence (100%) of gastrointestinal helminth infection in indigenous chickens in Mymensingh district. The results of Rabbi et al. (2006) were based on a non-random sample of 80 indigenous chicken's viscera. Mekibib et al. (2014) also reported similar prevalence (88.5%) of gastrointestinal helminth infections in scavenging chickens from Ethiopia. The range of reported prevalence of gastrointestinal helminth infections from other parts of the world varied from 59.0-100% (Wakelin, 1964; Romanenko et al., 1985; Guclu, 1994). But the disparity in between the result of the present and earlier works in other countries might be due to the variation among the geographical location of the research area, method of detection and sample size. The prevalence of *Ascaridia galli* was highest (41.56%) followed by Rabbi et al. (2006) detected species of nematodes *Ascaridia galli* 87.50%.

In Switzerland, 32 different commercial systems were compared and found that the prevalence of *A. galli* was 24.3% in the free- range system, 8.5% in deep-litter system

and none in battery cage system (Ola-Fadunsin , 2019), (Radfar, 2012), (Morgenstern and Lobsiger, 1993). Permin et al. (1997) reported high prevalence of *A. galli* in the free-range or organic (63.8%) compared with battery cage system (5%).

In Punjab, Pakistan *A. galli* was observed in 24% free range system and 2% in cage system farms (Bachaya et al., 2015). Improved hygienic measurements may eliminate the risk of *A. galli* infections in deep litter systems. The fact that bio-security measures are not strictly applied in free range poultry farming might help to explain establishment of nematodes. Therefore, factors other than wild bird for example farm to farm contamination via vehicle, machine, equipment or people might also have contributed as the source of initial infections, especially for *A. galli*.

When considering the gross pathological changes, it was revealed in this study that *A. galli* causes blockage of small intestine, petechial hemorrhage in the duodenum, marked inflammation and increased mucous secretion in small intestine. These pathological conditions are induced by the worms as they grab intestinal tissues after absorbing the digested food stuff. Sometimes, worms try to penetrate into the intestinal epithelium, resulting into necrosis and inflammation.

Moreover, this may also be due to the fact that embryonated eggs containing second stage larvae may be ingested and hatched in the intestinal wall, and produce gross pathological lesions, including intestinal hemorrhagic enteritis, necrotic patches and reddish spots on the intestinal wall. Similar types of lesions were recorded by Rabbi et al. (2006) and Adang et al. (2010) . (Dick et al.1973), . The exact mechanism of petechial hemorrhage is still unknown. However, the parasite, probably penetrate deeply into the mucosa. During penetration, large number of parasites might set up petechial hemorrhage. Necrotic plaque was also found in some cases which is supported by Ferdushy et al. (2016) and Permin et al. (1997).

CHAPTER 6: LIMITATION

Low positive case and made it difficult to get sufficient number of adult worms to run this experiment properly in due time. Within limited time due to pandemic situation we were able to conduct only microscopic examination.

CHAPTER 7: CONCLUSION

In our study presence of *Ascaridia galli* with moderate prevalence 10.2% was observed in the chickens which suggest that the environmental condition and the nature of the poultry rearing system are favorable for the transmission and persistence of the parasite species in hilly areas of Bangladesh.

The results of this study generated new knowledge in hilly chickens of *Ascaridia galli* for the first time. It will be mentioned that epidemiologic investigation will help to identify the strategy of *A. galli* for treatment and controlling of parasites in Bangladesh. Although this parasite is considered as one of the neglected parasites. This approach will provide hope for the poultry farmers to fight against devastating helminth infection in their birds. Thus, we can provide better economic returns to them.

Finally, we have found that the microscopic examination of parasitic egg is highly sensitive but time consuming for confirmatory diagnosis.

CHAPTER 8: REFERENCES

Ackert, J.E., 1931. The morphology and life history of the fowl nematode Ascaridia lineata (Schneider). *Parasitology*, *23*(3), pp.360-379.

Ackert, J.E., 1931. The morphology and life history of the fowl nematode Ascaridia lineata (Schneider). *Parasitology*, *23*(3), pp.360-379.

Adang, K.L., Abdu, P.A., Ajanusi, J.O., Oniye, S.J. and Ezealor, A.U., 2010. Histopathology of Ascaridia galli infection on the liver, lungs, intestines, heart and kidneys of experimentally infected domestic pigeons (C. l. domestica) in Zaria, Nigeria. *Pac. J. Sci. Technol*, *11*(2), pp.511-515.

Alam, M.N., Mostofa, M., Khan, M.A.H.N.A., Alim, M.A., Rahman, A.K.M.A. and Trisha, A.A., 2014. Prevalence of gastrointestinal helminth infections in indigenous chickens of selected areas of Barisal district, Bangladesh. *Bangladesh Journal of Veterinary Medicine*, *12*(2), 135-139.

Anon., 2015. Changes in global meat consumption by 2024. Here's why that matters. Available at: https://ensia.com/articles/these-mapsshow-changes-in-global-meat-consumption-by-2024-heres-whythat-matters/ (Accessed 12 Oct 2018).

Ansarey, F.H., 2012. Prospects of poultry industry in Bangladesh. In *Proceedings of the seminar and reception on Animal Husbandry Education and profession in Bangladesh-A journey of* (Vol. 50, pp. 62-65).

Appleby, M.C. and Hughes, B.O., 1991. Welfare of laying hens in cages and alternative systems: environmental, physical and behavioural aspects. *World's Poultry Science Journal*, *47*(2), pp.109-128.

Ashour, A.A., 1994. Scanning electron microscopy of Ascaridia galli (Schrank, 1788), Freeborn, 1923 and A. columbae (Linstow, 1903). *Journal of the Egyptian Society of Parasitology*, *24*(2), pp.349-355.

Ayudhya, C.K.N. and Sangvaranond, A., 1993. Internal parasites of alimentary tracts of adult native chickens in north-eastern part of Thailand. *Witthayasan Kasetsart (Sakha Witthayasat)*.

Bachaya, H.A., Raza, M.A., Anjum, M.A., Khan, I.A., Aziz, A., Manzoor, Z. and Munawar, S.H., 2015. Prevalence of Ascaridia galli in white leghorn layers and Fayoumi-Rhode Island red crossbred flock at government poultry farm Dina, Punjab, Pakistan. *Trop. Biomed*, *32*(1), pp.11-16.

Baig, S.M., Azhar, A., Hassan, H., Baig, J.M., Kiyani, A., Hameed, U., Rabbi, F., Bokhari, H., Aslam, M., Din, M.U. and Baig, S.A., 2006. Spectrum of beta-thalassemia mutations in various regions of Punjab and Islamabad, Pakistan: establishment of prenatal diagnosis. *haematologica*, *91*(3), pp.ELT02-ELT02.

Barua, A. and Yoshimura, Y., 1997. Rural poultry keeping in Bangladesh. *World's Poultry Science Journal*, *53*(4), pp.387-394.

Chan, A., Chiang, L.P., Hapuarachchi, H.C., Tan, C.H., Pang, S.C., Lee, R., Lee, K.S., Ng, L.C. and Lam-Phua, S.G., 2014. DNA barcoding: complementing morphological identification of mosquito species in Singapore. *Parasites & vectors*, *7*(1), pp.1-12.

Chege, H.W., Kemboi, D.C., Bebora, L.C., Maingi, N., Mbuthia, P.G., Nyaga, P.N., Njagi, L.W. and Githinji, J., 2015. Studies on seasonal prevalence of ecto-and endo-parasites in indigenous chicken of Mbeere Subcounty, Kenya. *Livestock Research for Rural Development*, *27*(6).

Da Silva, C.A. and Rankin, M., 2014. Contract farming for inclusive market access: Synthesis and findi Dahl, C., Permin, A., Christensen, J.P., Bisgaard, M., Muhairwa, A.P., Petersen, K.M.D., Poulsen, J.S.D. and Jensen, A.L., 2002. The effect of concurrent infections with Pasteurella multocida and *Ascaridia galli* on free range chickens. *Veterinary microbiology*, *86*(4), pp.313-324.ngs from selected international experiences *for inclusive market access*, p.1.

Dahl, C., Permin, A., Christensen, J.P., Bisgaard, M., Muhairwa, A.P., Petersen, K.M.D., Poulsen, J.S.D. and Jensen, A.L., 2002. The effect of concurrent infections with Pasteurella multocida and Ascaridia galli on free range chickens. *Veterinary microbiology*, *86*(4), pp.313-324.

Dänicke, S., Moors, E., Beineke, A. and Gauly, M., 2009. *Ascaridia galli* infection of pullets and intestinal viscosity: consequences for nutrient retention and gut morphology. *British poultry science*, *50*(4), pp.512-520.

Dick, J.W., Leland Jr, S.E. and Hansen, M.F., 1973. Hatching and in vitro cultivation of the nematode Ascaridia galli to the third-stage larva. *Transactions of the American Microscopical Society*, pp.225-230.

Fanatico, A.C., Cavitt, L.C., Pillai, P.B., Emmert, J.L. and Owens, C.M., 2005. Evaluation of slower-growing broiler genotypes grown with and without outdoor access: meat quality. *Poultry science*, *84*(11), pp.1785-1790.

Ferdushy T, Hasan MT and Kadir AKM 2014. Cross sectional epidemiological investigation on the prevalence of gastrointestinal helminthes in free range chickens in Narsingdi district, Bangladesh. Journal of Parasitic Disease DOI:10.1007/s12639-014-0585-5.

Ferdushy, T., Hasan, M. T., and Kadir, A. G. J. J. o. P. D. (2016). Cross sectional epidemiological investigation on the prevalence of gastrointestinal helminths in free range chickens in Narsingdi district, Bangladesh. 40(3), 818-822.

Fetterer, R.H. and Rhoads, M.L., 1993. Biochemistry of the nematode cuticle: relevance to parasitic nematodes of livestock. *Veterinary Parasitology*, *46*(1-4), pp.103-111.

Freeborn, S.B., 1923. Nicotine as a poultry vermifuge. *Science*, *57*(1485), pp.692-693.

Gauly, M., Duss, C. and Erhardt, G., 2007. Influence of Ascaridia galli infections and anthelmintic treatments on the behaviour and social ranks of laying hens (Gallus gallus domesticus). *Veterinary parasitology*, *146*(3-4).271-280.

Gordon, S.H. and Charles, D.R., 2002. *Niche and organic chicken products*. Nottingham University Press.

Guclu, F., 1994. Helminth fauna of fowls, turkeys, ducks and geese in the Ankara area. *Doga,-Turk-Veterinarlik-Vc-Hyavncilik-Dorgisi*, *18*, 79-86.

Hajibabaei, M., Janzen, D.H., Burns, J.M., Hallwachs, W. and Hebert, P.D., 2006. DNA barcodes distinguish species of tropical Lepidoptera. *Proceedings of the National Academy of Sciences*, *103*(4), pp.968-971.

Hansen, M.F., Terhaar, C.J. and Turner, D.S., 1956. Importance of the egg shell of Ascaridia galli to the infectivity of its larva. *The Journal of parasitology*, *42*(2), pp.122-125.

Hassanein, M.A., Rahman, E.A. and Khalil, F.A.M., 2009. New scanning electron microscopy look of Ascaridia galli (Schrank, 1788) adult worm and its biological control. *Research Journal of Parasitology*, *4*(4), pp.94-104.

Hassouni, T. and Belghyti, D., 2006. Distribution of gastrointestinal helminths in chicken farms in the Gharb region—Morocco. *Parasitology research*, *99*(2), pp.181-183.

Herd, R.P. and McNaught, D.J., 1975. Arrested development and the histotropic phase of Ascaridia galli in the chicken. *International journal for parasitology*, *5*(4), pp.401-406..

Höglund, J. and Jansson, D.S., 2011. Infection dynamics of *Ascaridia galli* in non-caged laying hens. *Veterinary parasitology*, *180*(3-4), pp.267-273.

Hoque, M.A., Hassan, M.M., Haque, E., Shaikat, A.H., Khan, S.A., Alim, A., Skerratt, L.F., Islam, A., Tun, H.M., Dissanayake, R. and Day, T.K., 2014. A survey of gastro-intestinal parasitic infection in domestic and wild birds in Chittagong and Greater Sylhet, Bangladesh. *Preventive Veterinary Medicine*, *117*(1), pp.305-312.

Hunduma, D., Regassa, C., Fufa, D., Endale, B. and Samson, L., 2010. Major constraints and health management of village poultry production in rift valley of Oromia, Ethiopia. *Global veterinaria*, *5*(1), pp.6-10.

Idika, I.K., Obi, C.F., Ezeh, I.O., Iheagwam, C.N., Njoku, I.N. and Nwosu, C.O., 2016. Gastrointestinal helminth parasites of local chickens from selected communities in Nsukka region of south eastern Nigeria. *Journal of Parasitic Diseases*, *40*(4), pp.1376-1380.

Ikeme, M.M., 1971. Weight changes in chickens placed on different levels of nutrition and varying degrees of repeated dosage with Ascaridia galli eggs. *Parasitology*, *63*(2), pp.251-260.

Ivanova, N.V., Zemlak, T.S., Hanner, R.H. and Hebert, P.D., 2007. Universal primer cocktails for fish DNA barcoding. *Molecular Ecology Notes*, *7*(4), pp.544-548.

Jansson, D.S., Nyman, A., Vågsholm, I., Christensson, D., Göransson, M., Fossum, O. and Höglund, J., 2010. Ascarid infections in laying hens kept in different housing systems. *Avian Pathology*, *39*(6), pp.525-532.

Jansson, D.S., Nyman, A., Vågsholm, I., Christensson, D., Göransson, M., Fossum, O. and Höglund, J., 2010. Ascarid infections in laying hens kept in different housing systems. *Avian Pathology*, *39*(6), pp.525-532.

Jansson, D.S., Nyman, A., Vågsholm, I., Christensson, D., Göransson, M., Fossum, O. and Höglund, J., 2010. Ascarid infections in laying hens kept in different housing systems. *Avian Pathology*, *39*(6), pp.

Joint, F.A.O., 2004. Human energy requirements. Report of a Joint FAO/WHO/UNU Expert Consultation, Rome, 17-24 October 2001.

Khalaf, F.I., Al-Ghadban, A., Al-Saleh, S. and Al-Omran, L., 1982. Sedimentology and mineralogy of Kuwait bay bottom sediments, Kuwait—Arabian Gulf. *Marine Geology*, *46*(1-2), pp.71-99.

Latif, M.A., 2001. Microcredit and savings of rural households in Bangladesh. *The Bangladesh Development Studies*, pp.51-71.

Magothe, T.M., Okeno, T.O., Muhuyi, W.B. and Kahi, A.K., 2012. Indigenous chicken production in Kenya: I. Current status. *World's Poultry Science Journal*, *68*(1), pp.119-132.

Mekibib, B., Dejene, H. and Sheferaw, D., 2014. Gastrontestinal helminthes of scavenging chickens in outskirts of Hawassa, Southern Ethiopia. *Global*

Moinard, C., Morisse, J.P. and Faure, J.M., 1998. Effect of cage area, cage height and perches on feather condition, bone breakage and mortality of laying hens. *British Poultry Science*, *39*(2), pp.198-202.

Morgenstern, R. and Lobsiger, C.H., 1993, September. Health of laying hens in alternative systems in practice. In *Proceedings of the 4th Europeen Symposium on Poultry Welfare. Edinburgh* (pp. 81-86).

Mushi, E.Z., Binta, M.G., Chabo, R.G., Ndebele, R. and Thibanyane, T., 2000. Helminth parasites of indigenous chickens in Oodi, Kgatleng District, Botswana. *Journal of the South African Veterinary Association*, *71*(4), pp.247-248.

Nzioka, M., 2000. Indigenous poultry production in the Katumani mandate District. Constraints and prospects. In *Proceedings of the end of Agricultural Research Project Phase II Conference* (pp. 213-225).

Ojok, L., 1993. Diseases as important factor affecting increased poultry production in Uganda. *Der Tropenlandwirt- Journal of Agriculture in the Tropics and Subtropics*, *94*(1), pp.37-44.

Ola-Fadunsin, S.D., Uwabujo, P.I., Sanda, I.M., Ganiyu, I.A., Hussain, K., Rabiu, M., Elelu, N. and Alayande, M.O., 2019. Gastrointestinal helminths of intensively managed poultry in Kwara Central, Kwara State, Nigeria: Its diversity, prevalence, intensity, and risk factors. *Veterinary world*, *12*(3), p.389.

Olsson, I.A.S., Duncan, I.J., Keeling, L.J. and Widowski, T.M., 2002. How important is social facilitation for dustbathing in laying hens?. *Applied Animal Behaviour Science*, *79*(4), pp.285-297.

Pankavich, J.A., Emro, J.E., Poeschel, G.P. and Richard, G.A., 1974. Observations on the life history of Ascaridia dissimilis (Perez Vigueras, 1931) and its relationship to Ascaridia galli (Schrank, 1788). *The Journal of parasitology*, pp.963-971.

Permin, A., Bisgaard, M., Frandsen, F., Pearman, M., Kold, J. and Nansen, P., 1999. Prevalence of gastrointestinal helminths in different poultry production systems. *British Poultry Science*, *40*(4), pp.439-443.

Permin, A., Christensen, J.P. and Bisgaard, M., 2006. Consequences of concurrent Ascaridia galli and Escherichia coli infections in chickens. *Acta Veterinaria Scandinavica*, *47*(1), pp.1-12.

Permin, A., Esmann, J.B., Hoj, C.H., Hove, T. and Mukaratirwa, S., 2002. Ecto-, endo- and haemoparasites in free-range chickens in the Goromonzi District in Zimbabwe. *Preventive veterinary medicine*, *54*(3), pp.213-224.

Permin, A., Magwisha, H., Kassuku, A.A., Nansen, P., Bisgaard, M., Frandsen, F. and Gibbons, L., 1997. A cross-sectional study of helminths in rural scavenging poultry in Tanzania in relation to season and climate. *Journal of Helminthology*, *71*(3), pp.233-240.

Phiri, I.K., Phiri, A.M., Ziela, M., Chota, A., Masuku, M. and Monrad, J., 2007. Prevalence and distribution of gastrointestinal helminths and their effects on weight gain in free-range chickens in Central Zambia. *Tropical Animal Health and Production*, *39*(4), pp.309-315.

Poulsen, J., Permin, A., Hindsbo, O., Yelifari, L., Nansen, P. and Bloch, P., 2000. Prevalence and distribution of gastro-intestinal helminths and haemoparasites in young scavenging chickens in upper eastern region of Ghana, West Africa. *Preventive Veterinary Medicine*, *45*(3-4), pp.237-245.

Prabakaran, R., 2003. Good practices in planning and management of integrated commercial poultry production in South Asia..

Rabbi, A.K.M.A., Islam, A., Majumder, S., Anisuzzaman, A. and Rahman, M.H., 2006. Gastrointestinal helminths infection in different types of poultry. *Bangladesh Journal of Veterinary Medicine*, *4*(1), pp.13-18.

Radfar, M.H., Khedri, J., Adinehbeigi, K., Nabavi, R. and Rahmani, K., 2012. Prevalence of parasites and associated risk factors in domestic pigeons (Columba livia domestica) and free-range backyard chickens of Sistan region, east of Iran. *Journal of parasitic diseases*, *36*(2), pp.220-225.

Raihan, S. and Mahmud, N., 2008. Trade and poverty linkages: A case study of the poultry industry in Bangladesh. *available at www. Cuts-citee. org/pdf/TDP-Book*, *1*.

Ramadan, H.H. and ABOUZNADA, N.Y., 1992. Morphology and life history of Ascaridia galli in the domestic fowl that are raised in Jeddah. *Science*, *4*(1).

Ramadan, H.H. and ABOUZNADA, N.Y., 1992. Morphology and life history of Ascaridia galli in the domestic fowl that are raised in Jeddah. *Science*, *4*(1).

Reid, W.M., 1960. Effects of temperature on the development of the eggs of Ascaridia galli. *The Journal of Parasitology*, *46*(1), pp.63-67.

Romanenko, P.T., Troenko, Y.A.I.A. and Kuzyakin, A.V., 1985. Age variation in helminth infection on chickens farm and factors farms in the Roostov region. *Nahrung*, *29*, pp.304-310.

Sabuni, Z.A., Mbuthia, P.G., Maingi, N., Nyaga, P.N., Njagi, L.W., Bebora, L.C. and Michieka, J.N., 2010. Prevalence of ectoparasites infestation in indigenous free-ranging village chickens in different agro-ecological zones in Kenya. *Livestock Research for Rural Development*, *22*(11), pp.1-4.

Sarker, A.J., 1976. The prevalence of avian diseases in Bangladesh Agricultural University poultry farm. *Bangladesh Veterinary Journal*, *10*(1-4), pp.672-678.

Shimmura, T., Hirahara, S., Azuma, T., Suzuki, T., Eguchi, Y., Uetake, K. and Tanaka, T., 2010. Multi-factorial investigation of various housing systems for laying hens. *British poultry science*, *51*(1), pp.31-42.

Sneath, P.H. and Sokal, R.R., 1973. *Numerical taxonomy. The principles and practice of numerical classification*.

Soulsby, E.J.L., 1982. Helminths. *Arthropods and Protozoa of domesticated animals*, *291*.

Saha, P.K., Saleque, M.A., Panaullah, G.M. and Bhuiyan, N.J., 2000. Fertilizer Management for Rice Based Cropping Systems Productivity. *Bangladesh Journal of Agriculture*, *25*(4), pp.555-560.

Soulsby, E.J.L., 1982. Helminths. *Arthropods and Protozoa of domesticated animals*, *291*.

Vali, N., 2008. Indigenous chicken production in Iran: a review. *Pakistan Journal of Biological Sciences: PJBS*, *11*(22), 2525-2531.

Van, N.T., Cuong, N.V., Yen, N.T., Nhi, N.T., Kiet, B.T., Hoang, N.V., Hien, V.B., Thwaites, G., Carrique-Mas, J.J. and Ribas, A., 2020. Characterization of gastrointestinal helminths and their impact in commercial small-scale chicken

flocks in the Mekong Delta of Vietnam. *Tropical animal health and production*, *52*(1), pp.53-62.

von Paula Schrank, F., 1788. *Verzeichniß der bisher hinlänglich bekannten eingeweidewürmer: nebst einer abhandlung über ihre anverwandtschaften*. Strobl.

Walker, T.R. and Farrell, D.J., 1976. Energy and nitrogen metabolism of diseased chickens: interaction of Ascaridia galli infestation and vitamin A status. *British poultry science*, *17*(1), 63-77.

Wakelin, D., 1964. A survey of the intestinal helminths parasitic in British domestic fowl. *Journal of Helmi* Ackert, J.E., 1931. The morphology and life history of the fowl nematode Ascaridia lineata (Schneider). *Parasitology*, *23*(3), pp.360-379. *Enthology*, *38*(1-2), pp.191-200.

Wakelin, D., 1964. A survey of the intestinal helminths parasitic in British domestic fowl. *Journal of Helminthology*, *38*(1-2), pp.191-200.

Wang, H., Naghavi, M., Allen, C., Barber, R.M., Bhutta, Z.A., Carter, A., Casey, D.C., Charlson, F.J., Chen, A.Z., Coates, M.M. and Coggeshall, M., 2016. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. *The lancet*, *388*(10053), pp.1459-1544.

Wattanachant, S., Benjakul, S. and Ledward, D.A., 2004. Composition, color, and texture of Thai indigenous and broiler chicken muscles. *Poultry science*, *83*(1), pp.123-128.

Wongrak, K., Daş, G., Moors, E., Sohnrey, B. and Gauly, M., 2014. Establishment of gastro-intestinal helminth infections in free-range chickens: a longitudinal on farm study. *Berliner Münchener Tierarztliche Wochenschrift*, *127*, pp.305-313.

QUESTIONNAIRE ON JUNGLE FOWL/HILLY CHICKEN

Case no.:	Date:	Phone no.:

A. General Information:

1. Owner's name:.....

2. Village: ..... Upazilla: ..... Zilla: .....

3. Educational status: a. <SSC b. =SSC c. =HSC d. =Degree/ Graduate.

4. Breed: .....

5. Flock size:.....

B. Case Information:

6. Sex: M/F.

7. Age:.....

C. Housing:

8. Types: intensive/ semi intensive/ extensive/free range

9.Litter type: wood shavings/ None.

D. Health & Deworming status:

10. Anthelmentics: Y/N.

11. Types (if given):.....

12. last dose given at (date):.....

13. Previous parasitic infection history by coproscopy: Y/N

14. Fecal Consistency: firm/ soft/ liquid.

15. Color of feces: Normal/ Bloody/ Yellowish/ Others.

16. Anemia: Present/ Absent. (M/m: pink/ pale)

E. Any disease (present):

17. Sign/ Symptoms:
.....
.....

18. Duration:
.....

19.
Rx:.....

20. Any vaccine: Y/N. (If Y. Name:
.....)

F. Nutritional Status:
21. Types of feed given:

BRIEF BIOGRAPHY OF THE AUTHOR

Kalpana Chakma passed the Secondary School Certificate Examination from Sapchari High School, Rangamati in 2009 with GPA 5.00 followed by Higher Secondary Certificate Examination from Rangamati Govt. Women College; Rangamati in 2011.She completed her graduation degree on Doctor of Veterinary Medicine (DVM) from Chittagong Veterinary and Animal Sciences University (CVASU), Bangladesh. As an intern student she received clinical training from Madras Veterinary College and Veterinary College and Research Institute, Namakkal, Tamilnadu, India. Now, she is in a candidate for the degree of MS in Parasitology, Dept. of Pathology and Parasitology, Faculty of Veterinary Medicine, CVASU.