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GASTROINTESTINAL PARASITISM AND ANTHELMINTIC EFFICACY IN CATTLE FROM FULBARIA UPAZILA OF MYMENSINGH, BANGLADESH

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ABSTRACT

Gastrointestinal parasitism and anthelmintic efficacy are of global concern for livestock and public health. An investigation on cattle gastrointestinal parasites and anthelmintic efficacy was conducted at Fulbaria Upazila, Mymensingh in 2017. Out of 100 fecal samples examined using simple sedimentation method, 70% cattle were found positive for parasites. The identified parasites were *Paramphistomum* spp. (27%), *Fasciola gigantica* (15%), *Schistosoma* spp. (10%), *Haemonchus* spp. (14 %) and *Balantidium coli* (12%). No significant variation was found in the prevalence rate between young (<2 years) and adult cattle (≥ 2 years). Significantly higher infection rate was recorded in male (81.63%) and in poor body conditioned animals (95.83%). For anthelmintic efficacy, feces from 50 animals were screened for eggs per gram (EPG) using McMaster technique. Twenty four cattle (>200 EPG) were allotted equally into three groups and further treated with either albendazole or ivermectin or kept as untreated control. EPG were again estimated for those animals at 14 days post-treatment. Status of anthelmintic efficacy was determined by using the fecal egg count reduction percentage (FECR %) test. The FECR % for albendazole and ivermectin were 98.76% and 95.01%, respectively. Results from this study indicated high parasitism in the study area and relatively higher efficacy of albendazole compared to ivermectin. Further studies are necessary to rule out the possibilities of anthelmintic resistance to parasites in cattle throughout the country as early as possible with a view to increase farmer awareness and to develop effective control strategies against endoparasites.

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INTRODUCTION

The contribution of livestock in the gross domestic product is 1.90% with a growth rate of 3.10% and cattle population of 247 lakh in Bangladesh (DLS, 2022). As a source of animal protein along with contribution in leather and other industry, cattle farming in Bangladesh is conventionally an employment opportunity for the poor, landless and destitute people. Therefore, the animal health is often compromised with various harmful pathogens because of poor hygiene, biosecurity, management and weaker host genetics. In addition to these, the topography, subtropical nature of climate and water logged low-lying feature of Bangladesh have made the ecological niche more suitable for parasite pathogens and their vectors. In fact, cattle of this country are reported to be susceptible to a number of endoparasites (Affroze et al., 2013; Sarker et al., 2014; Ahmed et al., 2015; Islam et al., 2015; Alam et al., 2018; Hossain et al., 2021; Khatun et al., 2021).

Among the GI parasites, *Fasciola gigantica*, *Paramphistomum*, *Schistosoma*, *Haemonchus, Trichostrogylus, Strogylus*, *Mecistocirrus*, *Toxocara*, *Moniezia*, *Balantidium coli*, *Eimeria* spp. etc. frequently affect the hosts (Soulsby, 1986; Affroze et al., 2013; Sarker et al., 2014; Ahmed et al., 2015; Islam et al., 2015; Alam et al., 2018; Hossain et al., 2021; Khatun et al., 2021) and challenge the health and productivity of cattle. Because of the high preference of gut as a habitat, these parasites often result in impaired digestion, malabsorption or reduced absorption of food nutrients and may cause bile duct or enteric obstruction. These may lead to inappetence, anemia, diarrhea, poor growth and economic loss. In cattle parasitic infections may lead to hypoproteinemia, pipe-stem liver, condemnation of infected organ, reduced vaccine efficacy and increased susceptibility to concurrent or secondary infections (Soulsby, 1986).

Bangladesh is endemic to various endoparasitic infections. Of these, snail-borne trematodes like *F. gigantica*, *Schistosoma*, *Paramphistomum* are available throughout the country with higher concern for areas with haors, lakes or river basins because of the availability of aquatic snail intermediate hosts (Affroze et al., 2013; Yasin et al., 2018). Intestinal schistosomiasis caused by *Schistosoma spindale* and *Schistosoma indicum* are widespread among cattle all over the country (Yasin et al., 2018). Worm infestations caused by a number of GI nematodes (*Haemonchus*, *Trichostrongylus, Trichuris*, *Oesophagostomum* etc.) also frequently affect our animals. Diarrheal agents, *Balantidium coli, Cryptosporidium,* coccidia fundamentally affect the GI tract of cattle in Bangladesh (Paul et al., 2019) and causes clinical manifestation from asymptomatic to serious dysenteric forms (Soulsby, 1986; Hastutiek et al., 2019).

Management of pasture and grazing pattern play extensive role in the control and prevention of GI parasites in developed countries (Scott et al., 2019b) in or without the inclusion of anthelmintic use (Radostits OM et al., 1994). Unfortunately in Bangladesh livestock production system is conventionally shared, non-specific pasture based that requires minimum investment in land, feed, or medicament for farm profitability. Therefore, transmission potentiality for soil-borne nematodes, feed-borne or snail-borne parasites is high. Considering the poor diagnostic facilities and the existing level of animal-welfare concern, broad-spectrum anthelmintic treatment is more practical necessity in Bangladesh.

Albendazole and ivermectin have been regularly and widely used in Bangladesh for controlling parasitic gastroenteritis in ruminants. There have been complaints on the failure of these anthelmintics to provide the expected degree of control with regard to parasitic gastroenteritis. The reason for inadequate efficacy of these anthelmintics is frequent and indiscriminate usage that might led to the development of resistance which is of major concern in developing countries of the world like Bangladesh (Soulsby, 1986; Dey et al., 2020a; Parvin S et al., 2022).

Accurate knowledge on the GI parasite diversity, intensity and prevalence is of high priority. Parasite ecology and epidemiology including infection pressure, environmental survival, seasonality, and changes to species diversity are significantly influenced by the current trend of industrialized livestock intensification, global climate change, anthelmintic resistance and animal welfare (Scott et al., 2019a). Anthelmintic efficacy and epidemiological pattern of the parasitic diseases in the different agro-climatic zones of the country usually provides a basis for developing strategic and tactical control systems against them. Although several epidemiological studies have been conducted, there is still scarcity of information about GI parasitic infections of cattle in Fulbaria upazila of Mymensingh district, Bangladesh. Therefore, the present study aimed to estimate the overall prevalence and risk factors of GI parasites in cattle at Fulbaria, Mymensingh and evaluated the efficacy of albendazole and ivermectin in their control.

MATERIAL AND METHODS

Study area, period and sampling strategy

One hundred fecal samples were randomly collected from the different villages under the union of Deokhola at Fulbaria Upazila for epidemiological study of GI parasites during the period from September to November, 2017. Fifty fecal samples were obtained from cattle of the Chan Mia Hazi Dairy Farm at Fulbaria, Deokhola, Mymensingh for anthelmintic resistance study. Coprological examination was performed in the Department of Parasitology, Bangladesh Agricultural University, Mymensingh (Figure 1). A pretested questionnaire was used to record the information like owner name and address, animal identification, age, sex, physical condition and deworming history. Animals were categorized based on age (young, less than 2 years and adult, 2 years or older), gender (male and female) and body condition (poor and normal body conditioned). The age of the animals was determined by interrogating the farmers and also by examining teeth.

Figure 1. Map of study area, Deokhola, Fulbaria upazila of Mymensingh district, Bangladesh

Sample processing and coproscopy

About 10-15 grams of feces were collected from the animals in a vial containing 10% formalin. The correctly filled, labeled and properly numbered vial were brought to the laboratory. Simple sedimentation method was followed to concentrate parasitic ova, cysts or oocyst according to Soulsby, (1986). Parasitic ova and cyst were identified as described by Thienpont et al. (1986).

EPG (Eggs per gram) counting by McMaster technique

McMaster technique was employed to the feces samples collected from tagged animals from farm to determine the EPG as per the guidelines by Soulsby, (1986). Cattle with an EPG count of at least 200 eggs per gram (EPG) were identified and divided in 3 groups each with 8 animals. Each group were treated with either albendazole or ivermectin or kept as untreated control. Dose determination was done as per the recommendation by the manufacturer.

FECRT to detect status of anthelmintic efficacy

Status of anthelmintic efficacy was detected by using the fecal egg count reduction percentage (FECR%) test and 95% confidence intervals.

Data analysis

Percentages to measure prevalence and chi-square test to determine the association between prevalence of helminth infection and age (among various age groups separately), sex (between male and female) and physical condition (between poor and normal body conditions) of the animals were the statistical tools calculated by SPSS version 25 to analyze the data.

FECRT

The percent reduction in fecal egg count was determined followed by the guidelines of World Association for the Advancement of Veterinary Parasitology (WAAVP) using arithmetic mean egg counts. The percent reduction was calculated using formula $100(1-X_t/X_c)$, where X_c stands for mean egg count of the untreated control group and X_t represents mean egg count of treated group. In case of 95% confidence interval estimation, when the lower limit of 95% confidence interval level and percent reduction in egg count were more than 90% and 95%, respectively; it was considered as susceptible. If any of the above mentioned criteria was not fulfilled, then it was considered as suspected resistance (Coles et al., 1992).

RESULTS

Overall prevalence of gastrointestinal parasites in cattle

During the study period out of 100 cattle examined, 70% animals were found infected with one or more species of gastrointestinal parasites (Table 1). A total of 4 genera of helminths and 1 genera of protozoa were identified. Of them, trematodes were *Paramphistomum* spp. (27%), *Fasciola gigantica* (15%), *Schistosoma* spp. (10%); nematodes namely, *Haemonchus* sp. (14%) and protozoa namely, *B. coli* (12%) (Figure 2). From this study, it was observed that the prevalence of *Paramphistomum* spp. (27%) was the highest whereas *Schistosoma* spp. (10%) infections were the lowest.

Table 1. Overall prevalence of gastrointestinal parasites in cattle

Name of Helminths	No. Infected (N=100)	Prevalence (%)
Paramphistomum spp.	27	27
Fasciola gigantica	15	15
Schistosoma spp.	10	10
Haemonchus spp.	14	14
Balantidium coli	12	12
Total	**70***	**70**

*=Total no animals affected is less than the summation of individual infection because same animal was infected by more than one type of parasites.

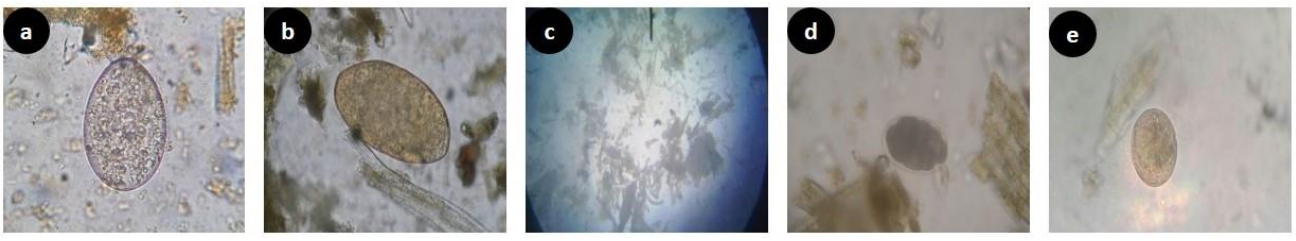

Figure 2. Microscopic images of identified parasitic eggs and cysts

Sex related prevalence of gastrointestinal parasites in cattle

In this study, prevalence of gastrointestinal parasites was higher ($p<0.01$) in male (81.63%) than female cattle (58.82%) (Table 2). However, the male cattle were 3.11 times more susceptible than female. In female, in case of trematodes, the prevalence rate of *Paramphistomum* spp. (23.52%), *F. gigantica* (9.80%), *Schistosoma* spp. (7.84%) was lower than those in male with *Paramphistomum* spp. (30.61%), *F. gigantica* (20.40%) and *Schistosoma* spp. (12.24%). In case of nematodes, in female, prevalence of *Haemonchus* spp. (11.76%) was relatively lower than those in male with *Haemonchus* spp. (16.32%). Prevalence of *B. coli* in female (15.68%) was higher than those in male (8.16%).

Table 2. Sex related prevalence of gastrointestinal parasites in cattle

Helminths	Male (N= 49)		Female (N=51)		Odd ratio	P Value
	No of infected	Percentage (%)	No of infected	Prevalence (%)	Male vs Female	
Paramphistomum spp.	15	30.61	12	23.52		
Fasciola gigantica	10	20.40	5	9.80		
Schistosoma spp.	6	12.24	4	7.84	3.11	.02*
Haemonchus spp.	8	16.32	6	11.76		
Balantidium coli	4	8.16	8	15.68		
Total	**40**	**81.63**	**30**	**58.82**		

*=Statistically significant ($p< .05$)

Age related prevalence of gastrointestinal parasites in cattle

Age of the host had an effect on the prevalence of gastrointestinal parasites of cattle. In this study, it was observed that adult (up to 2 years, 86.95%) were 3.6 times more susceptible to gastrointestinal parasites than young (less than 2 years, 64.93%). In young, highest infection rate was found in case of trematodes. On the other hand, in case of adult, highest infection was found in a protozoa, *B. coli* (Table 3).

Table 3. Age related prevalence of GI parasites in cattle

Age	Name of parasites	No. infected	Prevalence (%)	Odds ratio	P value
Less than 2 year (N=77)	*Paramphistomum* spp.	22	28.57		
	Fasciola gigantica	9	11.68		
	Schistosoma spp.	6	7.79		
	Haemonchus spp.	8	10.38		
	Balantidium coli	5	6.49		
	Total	**50**	**64.93**		
2 years and older (N=23)	*Paramphistomum* spp.	5	21.73	3.6	0.07 NS
	Fasciola gigantica	6	26.08		
	Schistosoma spp.	4	17.39		
	Haemonchus spp	6	26.08		
	Balantidium coli	7	30.43		
	Total	**20***	**86.95**		

*=Total no animals affected is less than the summation of individual infection because same animal was infected by more than one type of parasites; NS=Non significant ($p>.05$)

Physical condition related prevalence of gastrointestinal parasites in cattle

In the present study, poor body conditioned animals (95.83%) were 14 times more prone to GI parasites than normal body conditioned animals(61.84%) and it was statistically significant (p=.003) (Table 4).

Table 4. Physical condition related prevalence of gastrointestinal parasites in cattle

Physical condition	No. infected	Prevalence	Odds ratio	P-Value
Poor body conditioned animal (N=24)	23	95.83	Poor vs Normal (14.19)	0.003*
Normal body conditioned animal (N=76)	47	61.84		
Total	70	70		

*=Statistically significant (p<.003)

Anthelmintic efficacy of albendazole and ivermectin

Through clinical trial, our study revealed that albendazole treated group with the percentage of fecal egg count reduction is 98.76% and 95% confidence intervals level range from the 99.59% to 99.26% (Table 5). The FECRT% was found to be greater than 95% and the lower limit of 95% confidence interval was found to be greater than 90%. In ivermectin treated group, the FECR is 95.01% and 95% confidence intervals level range from the 98.34% to 84.93%. The FECR% was found to be greater than 95%, but 95% confidence interval (lower limit) was found to be less than 90%.

Table 5. The fecal egg count reduction percent (FECRT%) and 95% confidence intervals calculated for anthelmintics resistance to GI parasites in cattle

Anthelmentics	FECRT%	95% Confidence limit		Status
		Upper limit	Lower limit	
Albendazole	98.76	99.59	96.26	Susceptible
Ivermectin	95.01	98.34	84.93	Suspected resistance

DISCUSSION

Gastrointestinal parasitism is a common occurrence in the ruminants reared in a scavenging or semi-scavenging system in many countries of the world. Over all 70% prevalence of gastrointestinal parasitic infection in cattle was recorded in Fulbaria Upazila, Mymensingh of Bangladesh where the individual prevalence of *Paramphistomum* spp., *Fasciola gigantica*, *Schistosoma* spp., *Haemonchus* spp. and *B. coli* were 27%, 15%, 10%, 14% and 12%, respectively. This finding is similar to the findings of Ahmed et al. (2015) who recorded 72% of cattle infected with various helminths (*Paramphistomum* 30%, *Toxocara* 12%, *Fasciola* 10%, *Oesophagostomum* 8%, *Moniezia* 6% and *Trichostrongylus* 2%). Slightly lower prevalence was observed by Hossain et al. (2021) who recorded 49.7% ruminants were suffering from helminthiasis in the hilly areas of Mymensingh, Bangladesh. Our observation varied from the report of Hossain et al. (2016) who reported 20.37% cattle infested with endoparasites. Islam et al. (2015) reported *Haemonchus* 17.31%, *Oesophagostomum* 7.69%, *Trichostrongylus* 9.61%, *Trichuris* 5.77% and *Bunostomum* 3.84% in the study population of cattle. Karim et al. (2014) reported the prevalence of 12.4% fascioliasis, 8.8% paramphistomiasis and 37.8% GI nematodiasis in cattle. Yasin et al. (2018) found 68.9% cattle infested with snail-borne trematodes where rate of prevalence was 23.7% and 2.3% for schistosomiasis and fascioliasis in the Saint Martin's Island of Bangladesh, respectively. The prevalence of *B. coli* was 54.7% in cattle in Mymensingh as recorded in a study by Paul et al. (2019). The prominent variation in the species diversity and species prevalence in different studies might be affected by a number of factors. Difference in the sample size, selection of samples, breed, period and place of study, climatic conditions, managemental factors and the availability of intermediate hosts might be potential contributors to such situation. In this study, the influential factors on the variation of prevalence with other factors are difficult to explain. But it may be assumed that irregular deworming, imbalanced feed supplement and poor management practices may be associated with this variation.

Among the age group, higher rate of infection was found in adult (>2 years), and it was (86.95%). In adult, highest prevalence was recorded in case of *Balantidium coli* (30.43%). This result is very similar with the earlier record of Paul et al., (2019) who reported highest (70.4%) prevalence of *B coli* in adult cattle of Mymensingh district, Bangladesh followed by young (40.5%) and calves (31.3%). Differences in the individual immunological phenomenon of parasites contribute significantly in exhibiting the clinical manifestations as well as the prevalence rate in host animals. Moreover, differences in the diagnostic techniques and level of technicians' expertise may also play major role in the appropriate identification of parasites.

In the present study, male (81.63%) were significantly more susceptible to GI parasites infection than the female (58.82%). These findings were contradictory to the findings of Paul et al. (2019), Hossain et al. (2021) and Khatun et al. (2021) where they found significantly higher prevalence, 58.8%, 60.4% and 75.75%, respectively in female animals. The exact mechanism why this variation exists is not known. Poulin, (1996) reviewed the effects of host gender in the predisposition of parasitism and mentioned that male host might be vulnerable because of immunosuppression caused by testosterone hormone.

Hosts nutritional status are reflected in the body condition of animals and can influence the ability to adapt with the pathogenesis caused by parasitism and eventually to overcome it (Coop and Kyriazakis, 2001). In the present study, animals with poor body condition (95.83%) were significantly more susceptible to GI parasites infection than those with the normal body condition (61.84%). This finding is in agreement with the findings of Karim et al. (2021) who reported significantly higher infection in poor body conditioned animal than normal. The present study agreed with the statements of Lapage, (1956) who mentioned that malnourished animals are more susceptible to any infection as they are immunocompromised. It appears that malnutrition in animals increase the susceptibility to parasitic infection.

Development of anthelmintic resistance (AR) is gaining more concern for Bangladesh because of several recent findings from Rahman et al. (2018), Dey et al. (2020b) and Parvin et al. (2022). Our present study revealed that parasites recovered from the study farm animals were more susceptible to albendazole (98.76%) compared to ivermectin (95.01%) by FECR% tests. Reduced efficacy of selected anthelmintics in our study may be influenced by individual host immunity, lack of control on external environment and other managemental errors. The main factors that are thought to contribute to the development of resistance include frequent anthelmintic treatments, use of anthelmintics with a similar mode of action for several years, under dosing, treatments when there are few parasite in refugia and management of the stock to clean pastures combined with treatment (Coles et al., 2006; Dey et al., 2020b). Albendazole and ivermectin are now the most commonly used anthelmintic of resistance to this group of drugs. The general recommendation is to use anthelmintics from one action family in a year followed by a change to a different family every year (Coles et al., 2006). The practice of using one class of anthelmintics for a prolonged period before changing may have contributed to the selection of worms resistant to anthelmintic on the study farms. The level and type of AR in the gastrointestinal parasites in different farms appeared to be associated with the type and frequency of anthelmintic used and the management practices followed in the farms (Manikkavasagan et al., 2015; Dey et al., 2020b). The practice of changing an anthelmintic for its resistant problem is yet beyond knowledge of the farmers and clinicians of Bangladesh. The development of anthelmintic resistance poses a large threat to future production and welfare of grazing animals. FECR% test alone was used to study anthelmintic efficacy in this survey without use of confirmatory or supplementary control in in vivo study and in vitro tests (e.g., egg hatch assay, larval development assay, tubulin binding test, etc.). Hence, there is an urgent need to educate the farmers about the process, progress and problems of development of reduced anthelmintic efficacy or resistance and the ways to control it. Appropriate use of anthelmintics and good management will lead to delay in onset of resistance in gastrointestinal GI affecting animals.

CONCLUSIONS

Parasitism is one of the major problems affecting health and productivity of livestock. At present, anthelmintic resistance is a major threat to the current and future control program of helminth parasites throughout the world, including neighboring country. The high prevalence of GI parasitism in cattle at the study area suggests substantial negative effects on animal health. Sex and poor body condition of cattle had significant influence on the prevalence of GI parasitic infection. For treatment purpose, albendazole could be used effectively while ivermectin therapy should have strict follow-up to rule out the possibilities of development of resistance. The findings of the present study will broaden our knowledge on epidemiology of GI parasites as well as on anthelmintic efficacy in Bangladesh context.

COMPETING INTEREST

The authors declare that they have no competing interests.

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