Indian J Anim Health (2022), 61(1): 126- 131
DOI: https://doi.org/10.36062/ijah.2022.01622

Research Article

Prevalence of *Haemonchus contortus* in Black Bengal goats and histopathological characteristics in the infected abomasum

T. De[1], P. Srinivas[1], R. Hoque[2], S. Mondal[2], S. Pandit[1], S. Baidya[1], S. C. Mandal[1] and R. Jas[1*]

[1]Department of Veterinary Parasitology, West Bengal University of Animal and Fishery Science, Kolkata – 700 037, West Bengal, India; [2]Department of Veterinary Pathology, West Bengal University of Animal and Fishery Science, Kolkata – 700 037, West Bengal, India

Abstract

This communication reports the prevalence of *Haemonchus contortus* in Black Bengal goats and pathological changes of abomasum in the infected goats. During the period under report, a total of 330 abomasal samples were collected. The overall prevalence as well as intensity of *H. contortus* infection in terms of mean worm burden was 68.48% and 44.67, respectively. The prevalence and intensity were highest during the monsoon season. The uninfected abomasums showed more or less normal histological architecture. The infected abomasums exhibited necrosis and desquamation of mucosal glands. Infiltration of eosinophils and polymorphonuclear cells was also noticed in the mucosal layer. There were oedematic changes and mild proliferation of mucosa and submucosa of infected abomasums. From histopathological changes, we conclude that the infection was chronic, and this type of systematic study is a pre-requisite for formulating control measures against haemonchosis in small ruminants.

Key words: Abomasum, Goat, *Haemonchus contortus*, Histopathology, Prevalence

Highlights

- Prevalence of *Haemonchus contortus* was 68.48% in Black Bengal goats.
- The highest prevalence as well as intensity of infection was recorded in the monsoon.
- Infection was chronic in nature.

INTRODUCTION

India is an agrarian country, where 80 percent of landholders are small and marginal farmers, and therefore, livestock rearing is an essential aspect of their livelihood (Anon, 2010). Goat husbandry has distinct economic and managerial advantages over other livestock species due to its reduced initial investment requirement, low input requirement, higher prolificacy, early sexual maturity and ease of sale (Kumar and Pant, 2003). In West Bengal, the Black Bengal goats produce high-quality meat and skin, and are famous for their high prolificacy rate (Islam *et al*., 2016), and in a word, it is used as multipurpose animal. There are numerous factors that restrict the viability and profitability of goat farming in our country. Among these, parasitic gastroenteritis, primarily caused by worms, is the most significant impediment to optimal output. Gastrointestinal nematodes cause enormous economic losses due to illness, death, and weight loss (Jas *et al*., 2007; Jas and Ghosh, 2009; Jas *et al*., 2017a). *Haemonchus contortus* is the predominant gastrointestinal parasite infecting sheep and goats of India including West Bengal (Laha *et al*., 2013; Brahma *et al*., 2015; Jas *et al*., 2017b, 2020). *Haemonchus contortus* is a voracious bloodsucker that leads to anaemia in goats (Perry *et al*., 2002). The migratory activity of the adult stage and fourth larval stage cause haemorrhage in the wall of abomasum (Ijaz *et al*., 2009). Sheep infected with *H. contortus* showed significant haemorrhages in the mucosa

*Corresponding Author, E mail: rumajas@gmail.com

and sub-mucosa of abomasum with degeneration of abomasal epithelial cells (Ahmed *et al*., 2007). Many authors from different parts of the world reported the prevalence of *H. contortus* in small ruminants (Raza *et al*., 2009; Dagnachew *et al*., 2011; Sharma and Ganguly, 2016; Sultan *et al*., 2016; El-Ashram *et al*., 2017; Brik *et al*., 2019).

Most of the prevalence studies on *H. contortus* were based on coproscopy by finding eggs or larvae in the faecal sample of small ruminants. Prevalence of *H. contortus* based on coproculture and harvesting of infective larvae were recorded earlier by many workers (Brahma *et al*., 2015, 2018; Jas *et al*., 2017b, 2020) from the Department of Veterinary Parasitology, West Bengal University of Animal & Fishery Sciences, Kolkata. Therefore, the present study was designed to record the prevalence of *H. Contortus* in slaughtered Black Bengal goats of North 24 Parganas, West Bengal and also to observe the histopathological alterations in the abomasums of infected goats.

MATERIALS AND METHODS

Study area and duration: Three villages under the block Rajarhat of North 24 Parganas in West Bengal were selected for the present study. Abomasums of the slaughtered Black Bengal goats were collected from the local butcher's shop of the selected villages. The study was continued from March 2021 to January 2022. All three seasons were covered during the study period.

Collection and examination of abomasum for the presence of *H. contortus*: Thirty (30) abomasums were collected monthly from the local butcher's shop of the villages under Rajarhat block in North 24 Parganas for eleven months (from March 2021 to January 2022). Abomasums with all its contents obtained from the slaughtered goats were brought to the departmental laboratory by putting tight knots at both cut ends. In the laboratory, the abomasums were dissected with the help of surgical scissors, and the abomasal contents were taken in a dissection tray. After washing in tap water, both the abomasums and its contents were examined thoroughly for the presence of *H. contortus*. The worms were manually picked up by forceps and collected in normal saline solution (Jas *et al*., 2016). *Haemonchus contortus* were identified morphologically using the keys (Soulsby, 1982), and also the number of worms was counted to determine the mean worm burden.

Histopathological examination of infected and uninfected abomasums of Black Bengal goats: For histopathological studies, abomasums of slaughtered Black Bengal goats infected with *H. contortus* only were considered as infected, and abomasums without any worm infection were considered as control group. Tissue sections for histopathological examination were prepared from five infected as well as five control abomasums from Black Bengal goats following the standard method described by Lillie and Fullmer (1976). The tissue blocks were paraffin-embedded in accordance with standard procedure (Culling, 1974). Thin sections (4-5) were cut with a rotary microtome and stained with the standard Harris Haematoxylin and Eosin stain (Luna, 1968). Then the infected as well as uninfected abomasal sections were examined microscopically both in low power and high power.

RESULTS

Prevalence of *Haemonchus contortus* in Black Bengal goats: A total of 330 abomasums of Black Bengal goats slaughtered at the local abattoir of North 24 Parganas were examined during the study period to detect the prevalence of *Haemonchus contortus*. About 226 abomasums were found to be infected with *H. contortus,* indicating the overall prevalence of *H. contortus* was 68.48% in Black Bengal goats of West Bengal (Table 1). The highest prevalence of *H. contortus* was recorded during monsoon months (78.75%), and the lowest (60.00%) prevalence was observed during the

Table 1. Prevalence and intensity of infection of *H. contortus* in abomasums of slaughtered goats

Season	No. of abomasa examined	No. of infected abomasa	Prevalence (%)	Mean worm burden
Summer	120	72	60.00	30
Monsoon	120	94	78.75	72
Winter	90	60	66.67	35
Overall	330	226	68.48	44.67

summer months. The mean worm burden of *H. contortus* was 44.67 during the study period. The highest burden of worm was recorded during monsoon (72), followed by winter (35), and the lowest worm burden (30) was noted during the summer season (Table 1).

Histopathological observations: In the infected abomasums, the worms were found to be attached to the abomasal mucosa (Fig. 1). In some of the infected goats, the abomasal mucosa showed slight haemorrhagic lesions. The abomasal tissue of uninfected goat showed normal histological architecture (Fig. 2). All the four layers of abomasums *viz*., serosa, mucosa (epithelial layer and lamina propria), submucosa and tunica muscularis of uninfected goats exhibited more or less similar and normal histological structure.

In the abomasal tissue of two goats infected with *H. Contortus*, the glands were degenerated, and some of these were desquamated towards the lumen (Fig. 3). Epithelial cells within the glands were more eosinophilic and necrosed. Gastric pits were occasionally filled with cellular debris. Remnants of the parasite were found at the tips of the mucosal surface. Oedematic changes were noted in between glands in the deeper layer. Infiltrations of polymorphonuclear cells around the necrosed area were noted. Mild proliferative changes were evident in the mucosa muscularis layer. Blood vessels and lymphatics were mildly dilated, and unilocular adipose tissues were evident in the submucosal layer (Fig. 3).

Severe infiltration of inflammatory cells was observed in the mucosal layer, and most of the gastric glands were atrophied in another two infected goats (Fig. 4). The epithelial cell of the glands had severe irreversible changes. Some cells within glands became more eosinophilic and exuviated into the lumen of the gland. It was difficult to appreciate gastric pits. The epithelia on the surface were necrotic, disorganised, and incompletely incrusted. Necrotic and degenerative changes were noted along with a moderate amount of oedematic fluid both in the mucosal and submucosal stratum or layer. Stomal abundance extends upward from the muscularis mucosa among gastric glands with occasional displacement of gastric glands. Adipose cells were found to be strewn about in the submucosal area.

Oedema, desquamation, necrosis and severe infiltration of polymorphonuclear cells were observed in the mucosal part of one infected goat (Fig. 5). There were cirrhotic changes as most of the glands were replaced with infiltration. Remaining glands appeared to be highly active as these were distended longitudinally towards the lumen of the abomasum. Gastric pits were perceived within this area. Occasional smooth muscle fibres extend upward from the muscularis mucosa to surround gastric glands. Mild proliferative response in the submucosal area was appreciated. The muscularis mucosa was found to be hyperplastic in nature and formed the outermost layer of the mucosa. The elastic fibres in this layer were clearly visible. The blood vessels and lymphatic were found to be dilated. Voluminously adipose tissues were witnessed, which were tending to be coalesced in the submucosa. Section of adult parasite was found on the mucosal layer (Fig. 5).

DISCUSSION

The prevalence of *H. contortus* was quite high (68.48%) all-round the year as revealed by the presence of *H. contortus* worm in the abomasum of slaughtered Black Bengal goats. *Haemonchus contortus* was the predominant nematode parasite of small ruminants in India (Kumar *et al*., 2008; Singh *et al*., 2017) as well as in West Bengal (Jas *et al*., 2017b). The agroclimatic condition of West Bengal favours the development and translation of free-living larvae of *H. contortus* in the environment (Jas *et al*., 2017b). The climatic condition of West Bengal and the rearing practice i.e., semi-intensive system of rearing followed by the farmer are the reasons for high prevalence of *H. contortus* in Black Bengal goats in the present study. The prevalence as well as mean worm burden was the highest during monsoon season. This was in agreement with the findings of Laha *et al*. (2001). The relative humidity, rainfall and daily maximum and minimum temperature of West Bengal during monsoon are most favourable for development and survival of *H. contortus* larvae in the environment (Jas *et al*., 2017b) leading to highest prevalence and worm burden in abomasums of slaughtered Black Bengal goats. Besides, availability of lustre green grasses during monsoon also favours the higher transmission of infective larvae to the ruminant resulting highest prevalence and intensity of infection. Prevalence as well as mean worm burden of *H. contortus* was lower in summer and winter compared to monsoon season. High temperature and low humidity during summer and low temperature and low relative humidity during the winter season might be responsible for low prevalence and intensity of *H. contortus* worms in the abomasums of Black Bengal goats slaughtered at the local abattoir of North 24 Pargana in West Bengal.

Degeneration of mucosal glands, oedema, necrosis and severe infiltration of inflammatory cells particularly eosinophils were observed in the abomasal tissue of goats infected with *H. contortus*. Eosinophilic infiltration in the infected abomasal mucosa was also reported by many authors from different parts of the world (Nayebzadeh *et al*., 2005; Tehrani *et al*., 2012; Mannan *et al*., 2017). *In vitro* studies had shown that a number of ovine gastrointestinal nematode parasites secrete factors that enhanced infiltration/migration of eosinophils (Wildblood *et al*., 2005), and in haemonchosis eosinophils had been considered as the important component of cellular immunity against *H. contortus* (Balic *et al*., 2000). Infiltration of eosinophils to mucous glands and necrosis as observed in the present study were also reported earlier by Tehrani *et al*. (2012).

The mucosal glands in the infected abomasum became degenerated, necrosed and in some cases, it became cirrhotic due to infiltration of fibroblast cells. Desquamation and necrosis of mucosal glands might be due to continuous irritating and blood-sucking activity of both adult and immature *H. contortus* (Saminathan *et al*., 2015). Infiltration of polymorphonuclear cells in the mucosa as observed in the present study was in agreement with Nayebzadeh *et al*. (2005) who reported proliferation of macrophages and infiltration of lymphocytes and eosinophils around the adult parasites. Thickening of mucosa due to hyperplasia of mucous cells was reported by Saminathan *et al*. (2015) and Mannan *et al*. (2017). Mild proliferative response in the mucosal and submucosal layer along with the hyperplastic nature of muscularis mucosa was also observed in the present study.

Blood vessels and lymphatics were mildly dilated in the mucosal layer and oedematic changes were also observed in the mucosa and submucosa and also in between glands in the deeper layer. Oedematic changes might be due to hypoproteinaemia which is a common feature in chronic haemonchosis (El-Ashram *et al*., 2017). There was also severe infiltration of polymorphonuclear cells which led to increase the gap between the endothelial cells in the small venules of abomasal mucosa resulting into leakage of protein molecules which might be responsible for oedematic changes in the present

study. In the present study, sections of adult parasites were seen in the mucosal part of the abomasum. Therefore, cellular immune response including infiltration of inflammatory cells as well as polymorphonuclear cells was seen in the mucosal layer of the abomasum of infected goat.

Haemonchus contortus, the most pathogenic nematode of small ruminants was prevalent all-round the year in Black Bengal goats. The prevalence of *H. contortus* was quite high in Black Bengal goats. The histopathological changes in the abomasums of infected goats revealed the chronic nature of infection but in terms of severity it was also quite noticeable. The results obtained in the present study could be considered for strategic worm control programme in small ruminants of North 24 Parganas, West Bengal, India.

Conflict of interest: Authors have no conflict of interest in this study.

Author's contribution: TD: Investigation, methodology and data curation; PS: Data curation; RH: Investigation; SM: Resources and preparing original draft; SB: Methodology; SP: Data presentation; SCM: Editing; RJ: Conceptualisation, supervision and final editing.

REFERENCES

Ahmed OF, Mustafa SA and Omer BH, 2007. Pathogenesis of *Haemonchus contortus* in naturally and experimentally infected Sudanese Desert Sheep. Glob Vet, 5: 84-87

Anon, 2010. Animal husbandry Statistics Series-12. Government of India, Ministry of Agriculture, Department of Animal Husbandry Dairying and Fisheries, Krishi Bhawan, New Delhi

Balic A, Bowles VM and Meeusen EN, 2000. The immunology of gastrointestinal nematode infections in ruminants. Adv Parasitol, 45: 181-241, doi: 10.1016/s0065-308x(00)45005-0

Brahma A, Das S, Kumar D, Bordoloi G, Pandit S *et al.,* 2015. Prevalence of gastrointestinal parasites in Black Bengal goats of Sundarban delta in West Bengal. Int J Parasitol Res, 7(1): 156-159

Brahma A, Jas R, Das S and Ghosh JD, 2018. Prevalence of gastrointestinal helminth infection in Garole sheep of Sundarban Delta in West Bengal. J Anim Res, 8(1): 57-60, doi 10.30954/2277-940X.2018.00150.09

Brik K, Hassouni T, Elkharrim K and Belghyti D, 2019. A survey of *Haemonchus contortus* parasite of sheep from Gharb plain, Morocco. Parasite Epidemiol Control, 4: e00094, doi: 10.1016/j.parepi.2019.e00094

Culling CFA, 1974. Hand Book of Histopathological and HistochemicalTechniques, 3rd Edn., Butter Worth, London

Dagnachew S, Amamute A and Jemberu WT, 2011. Epidemiology of gastrointestinal helminthiasis of small ruminants in selected sites of North Gondar zone, Northwest Ethiopia. Ethiopian Vet J, 15(2), doi: 10.4314/evj.v15i2.67694

El-Ashram S, Nasr AI, Rashid M, Hu M, He L *et al*., 2017. *Haemonchus Contortus* and ovine host: A retrospective review. Int J Adv Res, 5(3): 972-999, doi: 10.21474/IJAR01/3597

Ijaz M, Khan MS, Avais M, Ashraf K, Ali MM *et al*., 2009. Infection rate and chemotherapy of various helminths in diarrhoeic sheep in and around Lahore. J Anim Plant Sci, 19(1):13-16

Islam F, Hossain MS, Sarker SC, Choudhury MP and Majumder A, 2016. Black Bengal goat keeping at Mymensingh Sadar upazila in Bangladesh. J Biosci Agric Res, 6(02): 541-546, doi: 10.18801/jbar.060216.64

Jas R and Ghosh JD, 2009. Economic impact of gastrointestinal nematodosis in sheep: enhanced meat production by anthelmintic treatment. Indian J Anim Sci, 79(8): 761-763

Jas R, Datta S and Ghosh JD, 2007. Economic impact of gastrointestinal nematodosis in goat on meat production. J Vet Parasitol, 21(2): 109-112

Jas R, Ghosh JD and Das K, 2016. Antigenic cross-reactivity among *Haemonchus contortus*, *Oesophagostomum columbianum* and *Trichuris ovis* of goat. Iranian J Parasitol, 11(4): 542-548

Jas R, Ghosh JD, Pandit S, Kumar D, Brahma A *et al.*, 2017a. Economic impact of gastrointestinal nematodosis in terms of meat production in small ruminants of West Bengal. Int J Microbiol Res, 9(1): 834-836

Jas R, Kumar D, Bhandari A and Pandit S, 2017b. Seasonal alteration in prevalence and intensity of naturally occurring gastrointestinal helminth infection in goats of New Alluvial zone of West Bengal, India. Biol Rhythm Res, 48(6): 867-876,

doi: 10.1080/09291016.2017.1317906

Jas R, Kumar D, Pandit S, Baidya S, Brahma A *et al*, 2020. Epidemiology of naturally occurring gastrointestinal helminthoses in buffalo of coastal zone of West Bengal, India. J Entomol Zool Stud, 8(5): 1512-1516

Kumar RR, Yadav CL, Garg R, Banerjee PS and Vatsya S, 2008. Prevalence of gastrointestinal nematodes in sheep and goat in some parts of north-west India. Indian J Anim Sci, 78(11): 1244-1246

Kumar S and Pant KP, 2003. Development perspective of goat rearing in India: Status issues and strategies. Indian J Agri Econ, 58(4): 752-767

Laha R, Das M and Gowswami A, 2013. Seasonal dynamics of gastrointestinal parasitic infections and prediction of *Haemonchus contortus* infections of goats in a sub-tropical hilly region of North-Eastern India. Indian J Anim Res, 47(4): 309-314

Laha R, Ramakrishna C, Bhattacharya D and Sikdar A, 2001. Seasonal incidence of *Haemonchus contortus* infection in goats- A postmortem study. Indian J Anim Sci, 71(4): 345-346

Lillie RD and Fullmer HM, 1976. Histopathologic Technique and Practical Histochemistry, 4th Edn., MC Graw Hill Book Company, New York

Luna LG, 1968. Manual of histologic staining methods of the Armed Forces Institute of Pathology, 3rd Edn., McGraw-Hill, New York

Mannan MA, Masuduzzaman M, Rakib TM, Chowdhury S and Hossain MA, 2017. Histopathological and haematological changes in haemonchosis caused by *Haemonchus contortus* in small ruminants of Bangladesh. Bangladesh J Vet Anim Sci, 5(2): 17-23

Nayebzadeh H, Seyfiabadshapouri M and Hoghooghi N, 2005. Immunisation of Arabian sheep against haemonchosis with *Haemonchus contortus* intestinal homogenate. 15th European Congress of Clinical Microbiology and Infectious Diseases (ECCMID), Copenhagen, Denmark

Perry BD, Randolph RF, McDermott JJ, Sones KR and Thornton PK, 2002. Investing in animal health research to alleviate poverty. International Livestock Research Institute (ILRI), Nairobi, Kenya, pp 148

Raza MA, Murtaza S and Bachaya HA, Dastager G and Hussain A, 2009. Point prevalence of Haemonchosis in sheep and goats slaughtered at Multan abattoir. J Anim Plant Sci, 19(3):158-159

Saminathan M, Gopalakrishnan A, Latchumikanthan A, Milton AAP, Aravind M *et al*., 2015. Histopathological and parasitological study of blood-sucking *Haemonchus contortus* infection in sheep. Adv Anim Vet Sci, 3(2): 99-108, doi: 10.14737/journal.aavs/2015/3.2.99.108

Sharma R and Ganguly S, 2016. Gastrointestinal nematodiasis in small ruminants and anthelmintic resistance: A review. J Immunol Immunopathol, 18(2): 100-104, doi: 10.5958/0973-9149.2016.00016.2

Singh E, Kaur P, Singla LD and Bal MS, 2017. Prevalence of gastrointestinal parasitism in small ruminants in western zone of Punjab, India. Vet World, 10(1): 61-66, doi: 10.14202/vetworld.2017.61-66

Soulsby EJL, 1982. A text book of Helminths, Arthropodes and Protozoa in Domesticated Animals. 7th Edn., ELBS and Bailliere Tindall, London

Sultan K, Elmonir W and Hegazy Y, 2016. Gastrointestinal parasites of sheep in Kafrelsheikh governorate, Egypt: prevalence, control and public health implications. Beni-Suef University J Basic App Sci, 5(1): 79-84, doi: 10.1016/j.bjbas.2015.12.001

Tehrani A, Javanbakht J, Jani M, Sasani F, Solati A *et al*., 2012. Histopathological study of *Haemonchus contortus* in Herrik sheep abomasum. J Bacteriol Parasitol, 3: 144, doi: 10.4172/2155-9597.1000144

Wildblood LA, Kerr K, Clark DA, Cameron A, Turner DG *et al*., 2005. Production of eosinophil chemoattractant activity by ovine gastrointestinal nematodes. Vet Immunol Immunopathol, 107 (1-2): 57-65, doi: 10.1016/j.vetimm.2005.03.010

Received – 01.02.2022, Accepted – 20.03.2022, Published - 15.05.2022 (Online), 01.06.2022 (Print)
Section Editor: Prof. S. N. Joardar, Associate Editor