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Research Article

ECONOMIC IMPACT OF GASTROINTESTINAL NEMATODOSIS IN TERMS OF MEAT PRODUCTION IN SMALL RUMINANTS OF WEST BENGAL

JAS R.*, GHOSH J. D., PANDIT S., KUMAR D., BRAHMA A., DAS S., DAS M. AND RALTE L.
Department of Veterinary Parasitology, Faculty of Veterinary and Animal Sciences, West Bengal University of Animal and Fishery Sciences; 37, Kshudiram Bose Sarani, Kolkata 700 037, India
*Corresponding Author: Email-rumajas@gmail.com

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Abstract- Economic impact of the naturally occurring gastrointestinal nematodosis was assessed in terms of meat production in sheep and goats. Both the animals were divided into two equals groups; one group was maintained as nematode free by anthelmintic treatment and the other group was allowed to harbour the parasite. Faecal egg count and body weight of all the animals were recorded at monthly interval for one year. The net loss in terms of rupees was estimated by taking into account of the final mean difference in body weight between the treated and infected groups, dressing percentage, the average rate of mutton (Rs. 350/-) and chevon (Rs. 450/-) in West Bengal and cost of anthelmintic treatment. The mean losses in body weight were 2.183 kg and 2.34 kg in infected sheep and goats, respectively with a per capita loss of 1.091 kg and 1.17 kg, meat production in infected animals. Therefore, the net economic losses due to gastrointestinal nematodosis were Rs. 361.05 and Rs. 512.10 in sheep and goats, respectively after taking in account the cost of anthelmintic.Therefore the strategic use of effective anthelmintic could constitute a viable tool for management of helminthic infection for enhancing the productivity of small ruminants.

Keywords- Gastrointestinal nematodes, Economic impact, Meat Production, Small Ruminants.

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Introduction

Gastrointestinal (g.i.) helminthosis along with the associated nutritional deficiency is the major constraint for optimum production in small ruminants [1]. Economic losses caused by the gastrointestinal helminthoses are primarily due to reduced weight gain in small ruminants [2, 3] and suboptimal productivity in large ruminants [4]. Small ruminants play important role in rural Indian economy constituting predominantly small and marginal farmers and landless labourers. Parasitic gastroenteritis due to nematode infection has been reported as a major constraint to profitable sheep and goat production in India including West Bengal [3, 5, 6]. Reports estimating the economic losses due to g.i. nematodoses in sheep and goats are scanty hence the present study was undertaken to determine the economic losses in terms of meat production due to naturally occurring g.i. nematodosis in sheep and goats of West Bengal.

Materials and Methods

Study Area

The present study was conducted on Garole sheep in one village under South 24 Parganas district and on Black Bengal goats in one village under the district of Hooghly in West Bengal. Sheep and goats of those villages were naturally infected with gastrointestinal nematodes. In both the places the animals were maintained by semi-intensive system and routine deworming was not practised in those villages. The study was conducted for a continuous period of one year from April, 2015 to March, 2016.

Selection and grouping of animals

A total of 100 Garole sheep and 100 Black Bengal goats of different ages and of either sex were coprologically screened by standard sedimentation and salt floatation techniques [7]for the presence of g.i. nematode eggs on two occasions at 3 days interval. The sheep and goats found positive for g.i. nematode eggs were subjected to quantitative faecal examination by modified Mc. Master's technique [7]. Sheep and goats having faecal egg count (FEC)>300 were identified and then 30 sheep and goats in the age groups of 3 – 6 months and of either sex were selected. Body weights of all the selected animals were recorded. The animals were divided into two equal groups in both the places with a comparable initial mean body weight and they were maintained according to the farmers' practices.

Anthelmintic treatment

One group of sheep (n=15) and one group of goat (n =15) were made g.i. nematode free by treating with Ivermectin (Ivomec® Indian Immunologicals) @ 200µg / kg body weight, sub-cutaneously and the other group of sheep (n=15) and goats (n=15) were served as infected untreated controls. Ten days following the treatment the faecal samples of all the selected sheep and goats were examined to determine the efficacy of Ivermectin, which was found to be 100% effective against g.i. nematodes. Subsequently throughout the study period Ivermectin was used for treating the sheep and goats of treated groups at two months intervals.

Examination of faecal samples

Faecal samples were collected per-rectally from all the sheep and goats under the study at monthly interval following the first anthelmintic treatment. Quantitative examinations of all the faecal samples were performed and monthly faecal egg count in terms of eggs per gram of faeces (EPG) was recorded by the modified

Mc. Master's technique [7].

Recording of body weight

For assessing the impact of g.i. nematode infection in terms of meat production in sheep and goats, body weights of all the selected animals were recorded simultaneously with the collection of faecal samples i.e. at monthly interval with the help of a floor balance.

Statistical Analysis

The body weights for each group on different post-treatment months were compared (Analyze-Compare Means). Then they were analyzed separately i.e. between groups and between post-treatment months by Duncan method (One-way- ANOVA) and the significance (p- value) was recorded at 5 % ($p<0.05$) level and 1 % ($p<0.01$) level. The complete statistical analyses were done with the help of Statistical Package for Social Scientist (SPSS), Windows Version 10.0.

Results

Considering the faecal egg count as an indicator for the intensity of g.i. nematode infection, monthly faecal egg count in terms of EPG of Strongyle group of nematodes were determined in all the infected sheep and goats. The highest faecal egg count in the infected groups of sheep (EPG=1193.33) and goats (EPG=1173.33) was recorded in the month of September with a mean EPG of 716.11 and 610.83 for sheep and goats, respectively [Fig-1].

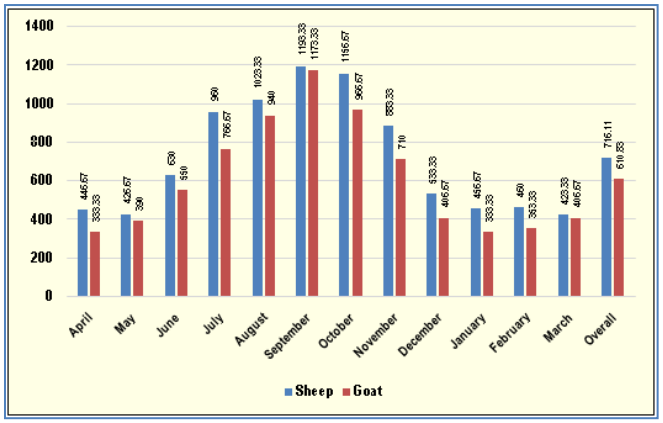

Fig-1 Mean faecal egg count of Strongyle group of nematodes in infected groups of sheep and goats

The economic impact of naturally occurring g.i. nematodosis in small ruminants was determined by comparing the body weight of treated and untreated animals at monthly interval during the study period. The final loss in mean body weight of sheep and goats due to g.i. nematodoses was converted into meat production loss by multiplying with the dressing percentage of sheep and goats (8). Then the final loss in meat production was converted in terms of rupees by multiplying with the average rate per kilogram of mutton (Rs. 350/-) and chevon(Rs. 450/-) in West Bengal.

The body weight of treated sheep increased significantly ($P<0.05$) from 2nd month post-treatment that the pre-treatment weight. The treated group of sheep showed significantly ($P<0.01$) higher body weight again on 4th month post-treatment and from 6th month post treatment body weight of treated sheep increased significantly ($P<0.01$) on every month post –treatment [Table-1]. The body weight of treated goats showed significant increase ($P<0.05$) compared to the pre-treatment weight on 3rd, 6th, 9th and at the end of the study [Table-2].In the infected groups of both sheep and goats [Table-1&2] the body weight increased significantly on 3rd, 6th, 9th month post treatment and after that it increased gradually ($P>0.05$).

On comparing the body weight of treated and infected groups of both sheep and goat it was recorded that the treated animals had higher body weight than the infected animals. Treated sheep showed significantly ($P<0.05$; $P<0.01$) higher body weight from 4th month post-treatment than the infected animals [Table-1]. Whereas the treated goats showed significant ($P<0.05$; $P<0.01$) increase in body weight from 5th month post-treatment than their infective counterparts [Table-2]. The final mean body weight of treated and untreated sheep was 9.486 kg and 7.303 kg, respectively with the mean loss in body weight was 2.183 kg [Table-3].

Table-1 *Changes in mean (±SE) body weight of different groups of sheep due to g.i. nematodoses*

Month	Treated	Control	P Value
April (1st treatment)	$5.266^{a} \pm 0.146$	$5.286^{a} \pm 0.149$	P= 0.925 (p>0.05)
May	$5.513^{ab} \pm 0.139$	$5.400^{a} \pm 0.144$	P= 0.577 (p>0.05)
June (2nd treatment)	$5.773^{bc} \pm 0.141$	$5.650^{ab} \pm 0.136$	P= 0.534 (p>0.05)
July	$6.103^{c} \pm 0.147$	$5.876^{bc} \pm 0.123$	P= 0.248 (p>0.05)
August (3rd treatment)	$6.476^{dx} \pm 0.141$	$6.090^{cdy} \pm 0.119$	P= 0.046 (p<0.05)
September	$6.826^{dx} \pm 0.134$	$6.236^{cdey} \pm 0.123$	P= 0.003 (p<0.01)
October (4th treatment)	$7.280^{ex} \pm 0.128$	$6.413^{defy} \pm 0.133$	P= 0.000 (p<0.01)
November	$7.653^{fx} \pm 0.111$	$6.623^{efgy} \pm 0.134$	P= 0.000 (p<0.01)
December (5th treatment)	$8.186^{gx} \pm 0.096$	$6.790^{fghy} \pm 0.136$	P= 0.000 (p<0.01)
January	$8.703^{hx} \pm 0.090$	$6.896^{hiy} \pm 0.132$	P= 0.000 (p<0.01)
February (6th treatment)	$9.113^{ix} \pm 0.106$	$7.163^{iy} \pm 0.152$	P= 0.000 (p<0.01)
March	$9.486^{jx} \pm 0.115$	$7.303^{jy} \pm 0.151$	P= 0.000 (p<0.01)
P value	P = 0.000(p<0.01)	P = 0.000(p<0.01)	**N = 15**

Table-2 *Changes in mean (±SE) body weight of different groups of goats due to g.i. nematodoses*

Month	Treated	Control	P value
April (1st treatment)	$5.086^{a} \pm 0.298$	$5.093^{a} \pm 0.180$	P= 0.985 (p>0.05)
May	$5.446^{ab} \pm 0.299$	$5.370^{ab} \pm 0.179$	P= 0.828 (p>0.05)
June (2nd treatment)	$5.833^{abc} \pm 0.304$	$5.546^{abc} \pm 0.185$	P= 0.428 (p>0.05)
July	$6.190^{bcd} \pm 0.287$	$5.750^{bcd} \pm 0.184$	P= 0.208 (p>0.05)
August (3rd treatment)	$6.576^{cde} \pm 0.296$	$5.930^{cde} \pm 0.185$	P= 0.074 (p>0.05)
September	$6.923^{defx} \pm 0.300$	$6.133^{defy} \pm 0.180$	P= 0.032 (p<0.05)
October (4th treatment)	$7.323^{efgx} \pm 0.302$	$6.356^{efgy} \pm 0.177$	P= 0.010 (p<0.05)
November	$7.706^{fgx} \pm 0.308$	$6.610^{fghy} \pm 0.176$	P= 0.005 (p<0.01)
December (5th treatment)	$8.213^{ghx} \pm 0.311$	$6.793^{ghiy} \pm 0.180$	P= 0.000 (p<0.01)
January	$8.713^{hix} \pm 0.314$	$6.973^{hiiy} \pm 0.169$	P= 0.000 (p<0.01)
February (6th treatment)	$9.213^{iix} \pm 0.312$	$7.173^{iiy} \pm 0.171$	P= 0.000 (p<0.01)
March	$9.743^{jx} \pm 0.303$	$7.403^{jy} \pm 0.174$	P= 0.000 (p<0.01)
P value	P = 0.000(p<0.01)	P = 0.000(p<0.01)	**N = 15**

Consequently the mean loss in body weight of infected goat was 2.34 kg. The mean loss in meat production in sheep and goat were 1.091 kg and 1.17 kg, respectively considering the dressing percentage of sheep and goat as 50% (8). Therefore the economic loss in meat production in terms of rupees were Rs. 381.85 and Rs. 526.50 for sheep and goats, respectively considering the average rate of mutton (Rs. 350/-) and chevon (Rs. 450/-). On the other hand the net economic gain per treated animal due to Ivermectin treatment was Rs. 361.65 for sheep and Rs. 512.10 for goats after taking in account the cost Ivermectin required during the entire study period [Table-3].

Table-3 *Economic impact of naturally occurring gastrointestinal nematodosis in small ruminants*

Animal Species	Body weight gain in treated group	Loss in meat production in infected group	Mean loss in terms of Rs.	Mean amount of anthelmintic needed for the treated group	Mean Cost of anthelmintic treatment	Net economic loss
Sheep	2.183 kg	1.091 kg	381.85 (1.091x350)	≅ 13mg	Rs. 20.80	Rs. 361.05
Goat	2.34 kg	1.17 kg	526.50 (1.17x450)	≅ 9mg	Rs.14.40	Rs.512.10

Discussion

The untreated sheep and goats under the study harboured g. i. nematode infections during the entire study period as revealed from their Coprological examination. Very little critical study on economic losses due to g.i. helminth parasites has so far been conducted in India but circumstantial evidence indicates that they are responsible for a marked loss in production [3]. Helminth parasitic infections are generally chronic and sub-clinical in nature and the losses caused by them are insidious while *Haemonchus contortus* infection may cause spectacular production losses in small ruminants [9].

The results of the present study revealed that the g.i. nematode infections caused significant ($P<0.01$) reduction in body weight of infected animals compared to the parasite free animals. The reduced body weight gain in the infected sheep and goats indicates the negative impact of g.i. nematode infections on the growth rate as the young growing animals were selected for the present study. The reduction in body weight due to g.i. nematodes as recorded in the present study was also reported earlier [2, 3, 10-12]. Normal burdens of worms are responsible for reduced growth rate in animals and even a sub-clinical infection may also result in depressed weight gain [9]. In the present study a moderate burden of Strongly group of nematodes (sheep –716.11 and goat 610.83) has been recorded and therefore the decreased body weight in untreated animals was obvious.

The decreased rate of body weight gain in infected animals might be attributed to reduced feed intake and feed conversion efficiency due nematode infection [1]. The exact mechanism of reduced feed intake in infected animals is not clear but it has been proposed that the abdominal pain, gut inflammation, changes in pH of gut contents, changes in flow rate of digesta, changes in protein to energy ratio of absorbed nutrients and in the secretion of gut hormone cholecystokinin contribute to the reduced body weight gain infected animals [13]. Reduced feed conversion efficiency might be another important factor for decreased body weight gain in infected animals and it has been estimated that reduced feed utilization contributes about 20 -25 g of body weight / day [14]. Reduced feed conversion efficiency due g.i. nematode infections results from impaired protein digestion and increased catabolism of protein in addition to reduced feed intake [14].

Conclusion

Gastrointestinal nematode infection causes economic losses in terms of meat production in small ruminants. Therefore, the management of gastrointestinal parasitic infections by the strategic use of effective anthelmintics could constitute a viable tool for enhancing the productivity of small ruminants.

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Abbreviations: g.i. - Gastrointestinal, FEC - Faecal egg count, EPG - Eggs per gram

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors. In this study animals were maintained by the farmers and no captivity and no painful experiments were carried out using those animals.

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