

## EVALUATION OF ANTHELMINTIC EFFICACY OF IVERMECTIN, LEVAMISOLE HCL AND ALBENDAZOLE ADMINISTERED THROUGH DIFFERENT ROUTES AGAINST NATURALLY OCCURRING GASTROINTESTINAL NEMATODIASIS IN BLACK BENGAL GOAT INDUCING HEMATOLOGICAL PARAMETERS AND LIVE WEIGHT INDICES

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This study aimed to evaluate the efficacy of ivermectin, levamisole HCl and albendazole against gastrointestinal nematodes in naturally infected goats of government goat development farm, Sylhet, Bangladesh. The study included 52 black Bengal breed of which 30 were naturally infected and randomly selected 20 on the basis of their weight and egg count. Twenty black Bengal goats of 12-13 month old irrespective of sex infested with gastrointestinal nematodes were selected for this experiment and randomly divided into four equal groups (group A, B, C and D) where each group consisted of 5 goats and goats of group D were kept as control group. One injectable ivermectin (200µgkg<sup>-1</sup> body weight, S/C) preparations (Techno Drugs Ltd. Bangladesh) and two solid levamisole HCl, albendazole (7.5 mgkg<sup>-1</sup> body weight, orally) preparations (The ACME Laboratories Ltd. and Square Pharmaceuticals Ltd. Bangladesh) were used for positive control of gastrointestinal nematodes as group A, B and C. Goats of group D was kept as control without giving any treatment. Before trials (day 0), total egg count, blood samples and initial body weight were recorded. During the study period the fecal and blood samples were collected directly from rectum and examined on 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> day using McMaster fecal egg counting method. Body weight was

recorded on day 28 following the treatments. The results of the comparative efficacies of different anthelmintic of ivermectin was 86.75%, followed by levamisole HCl 85.07% and albendazole 92.81%. McMaster fecal egg counting method discloses the percentage of *Haemonchus* spp. (15.38%), with *Trichostrongylus* spp, *Strongyloides* spp., and *Cooperia* spp. also present. After treatment with ivermectin, levamisole HCl and albendazole, Total Erythrocyte Count (TEC), Hemoglobin (Hb) content and Packed Cell Volume (PCV) were increased significantly (p<0.01 and p>0.05) in goats but Erythrocyte Sedimentation Rate (ESR) and Total Leukocyte Count (TLC) were decreased significantly (p<0.05 and p>0.01) in all treated goat and body weight was increased significantly (p<0.01) on day 28. The farm management practices along with results of the present study revealed the efficacy of multiple anthelmintic against gastrointestinal nematodes in goats. Additional detailed studies are required to clarify the current status of the efficacy of the anthelmintic widely used in different agro ecologies, animal species, and livestock management systems in Bangladesh.

**Key word:** Comparative efficacy, anthelmintic, EPG (eggs per gram), hematology, body weight, gastrointestinal nematodes, goats and Sylhet.

Bangladesh is an agro based country. The livestock is an important sub-sector which is considered to be the backbone of agriculture in Bangladesh (BBS, 1998) and approximately 80% people depend on it directly or indirectly for their subsistence. Among livestock, the population in Bangladesh is currently estimated to comprise 20.75 million goats (DLS, 2007). Black Bengal Goat rearing is very popular in Bangladesh and treated locally as “cow of poor people”. Goats play a vital role in the subsistence economy of smallholders in Bangladesh. There are about 38.1 million small ruminants (goats and sheep) in Bangladesh (FAO, 2005) which play a important role in the rural economy and earn substantial amount of foreign currency by exporting skins and other by products (Kamaruddin, 2003). Goat rearing contributes greatly to the poverty stricken rural people, especially to small and marginal farmers and landless laborers holding less than 2 acres of land (Husain et al., 1998; SAIC, 1995). The domestic goat is a sociable, inquisitive, and intelligent species, which has been used for its meat, milk, skin, and fur since it was first domesticated 10,000 years ago (Genaro et al., 2010). The climatic condition of Bangladesh is favorable to the ecological conditions suitable for parasites of which the helminth parasite predominates. Parasitism has been considered as one of the major constraints of livestock production (Jabbar and Green, 1983), helminthiasis especially gastrointestinal nematodiasis overwhelming a severe havoc on health and production (Rehman et al., 2009, Perry et al., 2002; Sahlou et al., 2009) throughout the world due to impacts on economy also (Silvestre et al., 2000) and market value of the living animals (Islam, 1985) with a high rate of anthelmintic resistance prevalence (Howell et al., 2008; Kaplan et al., 2004). The main gastrointestinal nematodes playing lower productivity Black Bengal Goats typically take account of *Haemonchus*, *Oesophagostomum*, *Ostertagia*, *Cchabertia*, *Nematodirus*, *Trichuris*, *Moniezia* and *Fasciola* (Husnain and Usmani, 2006). The incidence of gastrointestinal nematodes in goats and sheep in Mymensingh was

reported by Haq and Shaikh (1968). The use of sustainable, integrated parasite control systems, using scientifically proven non-chemical methods and limited use of drugs is being considered to ensure animal health and food safety (Waller, 2006). We can prevent and control the parasitic diseases by using a routine prophylactic anthelmintics measurement. The anthelmintic activities and therapy of ivermectin, levamisole HCl and albendazole have been studied (Dale and Haylett, 2004). Ivermectin produces flacid paralysis of parasites by acting as an agonist of the neurotransmitter Gamma Amino Butyric Acid (GABA), thereby disrupting GABA-mediated Central Nervous System (CNS) neurosynaptic transmission (Dacasto and Cocuzza, 1995), albendazole act by inhibiting tubulin polymerization, whereas oxclozanide lowers the essential ATP through uncoupling oxidative phosphorylation (Einsteinm et al., 1994). Modern anthelmintic such as Benzimidazoles like albendazole and levamisole HCl are widely used in Bangladesh and very recently ivermectin is being used sporadically. The present investigation was aimed to evaluate the effect of modern anthelmintics Vermic® (Ivermectin), Levavet® (Levamisole HCl) and Almex-vet® (Albendazole) against gastrointestinal nematodiasis in goats irrespective to the species involved and their effects on the basis of EPG (eggs per gram) count, body weight of goats and hematological parameters like Total Erythrocyte Count (TEC), Hemoglobin % (Hb%), Packed Cell Volume (PCV), Erythrocyte Sedimentation Rate (ESR) and Total Leukocyte Count (TLC) were also included in this investigation.

## MATERIALS AND METHODS

The experiment was conducted in the Department of Physiology and Pharmacology, Sylhet Agricultural University, Sylhet and Government Goat Development farm, Sylhet, Bangladesh was selected for this study. The research was carried out during the period of July to November, 2010. The following procedures were adopted for performing the experiment. Twenty goats of 12-13 months old are

selected within the randomly sampling goats which were severely infected with gastrointestinal nematodiasis irrespective of the species of parasites involved. These twenty goats were randomly divided into four groups each comprising of five goats and marked as A, B, C and D.

Weekly EPG (eggs per gram) count was done on day 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> post treatment by McMaster egg counting technique. McMaster fecal egg count method described by Gordong and Whitlock (1939) was used. With sterile syringe and needle maintaining aseptic condition, 5 ml of blood sample was collected from jugular vein of each goat and kept in vials containing anticoagulant (sodium- EDTA) and this was done on day of 0, 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> during experimental period. Blood and fecal samples were collected from each goat and after prescribing a proper identification tag it and were immediately brought to the Physiology and Pharmacology Laboratory, Sylhet, Bangladesh for fecal examination. The hematological parameters were examined in the laboratory of the Department of Physiology and Pharmacology, Sylhet, Bangladesh. Live weight gain of each group on recorded on day 0 and 28 using digital weight balance.

Goats of group A were treated with Vermic injection (Ivermectin 1%, Techno drugs Ltd. Bangladesh) subcutaneously at the dose rate of  $200\mu\text{gkg}^{-1}$  body weight, group B were treated with tablet Levavet (Levamisole HCl, The ACME Laboratories Ltd, Bangladesh) orally at the dose rate of  $7.5\text{mgkg}^{-1}$  body weight, group C were treated with tablet Almex-Vet (Albendazole, Square Pharmaceuticals Ltd, Bangladesh) orally at the dose rate of  $7.5\text{mgkg}^{-1}$  body weight and goats of group D served as untreated control. All the goats of treated and control groups were closely observed for 28 days after treatment. The fecal samples were collected from the treated and control groups of goats on 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> day of treatment to investigate the fecal egg count. The blood samples were collected from the treated and

untreated control groups on the day '28' of treatment and hematological parameters TEC, Hb, PCV, ESR and TLC were determined as per method by Coffin (1995). All the data were statistically analyzed by the computer using statistical package programmed MSTAT-C developed by Russel (1996) and following the standard methods by Snedecor and Cochran (1967). A one way ANOVA method was made by F variance test. The eggs of parasites were identified on the basis of morphological characteristics as described by Soulsby (1986) and then counted.

## RESULTS AND DISCUSSION

The results of the comparative efficacy of ivermectin, levamisole HCl and albendazole based on fecal egg counts reduction on naturally infested goats are presented in (Table 1). In the treatment group A mean EPG (eggs per gram) count before treatment  $314.00\pm 17.78$  and after treatment mean EPG (eggs per gram) on 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> day were  $43.20\pm 2.03$ ,  $54.40\pm 1.63$ ,  $46.00\pm 2.92$  and  $41.60\pm 1.44$  respectively. The rate of reduction of mean EPG (eggs per gram) on 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> day after treatment was 93.24%, 90.68%, 88.53% and 86.75% respectively. In conformity to the present findings, Islam et al., (1994), Ponikarov (1989), Shastri (1989), Baggerwal et al., (1991), Mukherjee et al., (1994), Docastro and Cocuzza (1995) and Yadav et al., (1996) observed similar results in goat. Likewise Amin et al., (2005), Hosseinei et al., (2000) and Praslicka et al., (1995) reported similar findings in sheep. Similar results have also been stated by some researchers, Stevenson et al., (2002) in sheep and Islam et al., (2003) in buffaloes. It seems that a few works was carried out previously to determine the efficacy of these anthelmintics in Bangladesh. It occurred due to the potency of different anthelmintic against gastrointestinal nematodiasis in goats. This study revealed that albendazole is most effective anthelmintics against gastrointestinal nematodiasis in goats.

Table 1. Efficacy of ivermectin, levamisole HCl and albendazole on egg count EPG (eggs per gram) in gastrointestinal nematodiasis in goats

Group	Treatment	Pre-treatment	Post-treatment							
		Day 0	Day 7		Day 14		Day 21		Day 28	
		Mean ±SE	Mean ±SE	%	Mean ±SE	%	Mean ±SE	%	Mean ±SE	%
G <sub>A</sub>	Inj. Vermic®	314.00 ± 17.78	43.20 ± 2.03**	93.24	54.40 ± 1.63**	90.6 8	46.00 ± 2.92**	88.53	41.60 ± 1.44**	86.75
G <sub>B</sub>	Levavet®	288.00 ± 8.00	70.60 ± 1.63**	94.49	83.60 ± 2.32**	90.9 7	65.00 ± 0.95**	87.43	43.00 ± 2.00**	85.07
G <sub>C</sub>	Almex-vet®	306.00 ± 8.72	82.20 ± 0.86**	97.14	65.00 ± 2.24**	95.7 6	47.00 ± 4.64**	93.64	22.00 ± 1.22**	92.81
G <sub>D</sub>	Control group	295.00 ± 5.48	314.00 ± 5.10**	0.34	334.00 ± 3.32**	2.03	354.00 ± 3.32**	4.75	379.00 ± 9.70**	9.15

\*\* = Significant at 1 percent level ( $p < 0.01$  and  $p > 0.05$ )

In treatment group B, the pre-treatment mean EPG (eggs per gram) count was  $288.00 \pm 8.00$  and the post-treatment mean EPG (eggs per gram) count values at 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> day were  $70.60 \pm 1.63$ ,  $83.60 \pm 2.32$ ,  $65.00 \pm 0.95$  and  $43.00 \pm 2.00$  respectively. The rate of reductions were significantly increased to the extent of mean EPG (eggs per gram) on 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> day after treatment were 94.49%, 90.97%, 87.43% and 85.07% respectively. The result is more or less similar by earlier reported Beck *et al.*, (1971); Sharma and Jagadish (1991); Prodhon *et al.*, (1993); Thejeomooethy *et al.*, (1995); Vesconcelos *et al.*, (1995) and Williams and Broussard (1995). Haq *et al.*, (1984) reported that levamisole at the dose rate of  $8.5 \text{ mg kg}^{-1}$  body weight was 100% effective in goats naturally infected with various gastrointestinal nematodes. The findings of the present study are more or less similar to the earlier researchers.

In treatment group C, the pre-treatment mean EPG (eggs per gram) count was  $306.00 \pm 8.72$  and the post-treatment mean EPG (eggs per gram) count values at 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> day were  $82.20 \pm 0.86$ ,  $65.00 \pm 2.24$ ,  $47.00 \pm 4.64$  and  $22.00 \pm 1.22$  respectively. The rate of reductions were significantly increased to the extent of mean

EPG (eggs per gram) on 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> day after treatment were 86.12%. This result in conformity with the earlier workers, Guha *et al.*, (1996), Pomroy *et al.*, (1998), Guha and Banerjee (1987). Ram *et al.*, (2007) studied the comparative efficacy of albendazole, albendazole plus radoxanide combination, ivermectin and doramectin. This study was conducted in Pashmina goats infested with *Haemonchus* spp and maintained at high altitude (>2350 m above sea level).

Mean body weight of untreated control group D (day 0) EPG (eggs per gram) count was  $295.00 \pm 5.48$  and on the EPG (eggs per gram) count values at 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> day were  $314.00 \pm 5.10$ ,  $334.00 \pm 3.32$ ,  $354.00 \pm 3.32$  and  $379.00 \pm 9.70$  respectively and the rate of EPG (eggs per gram) count was increased. The efficacies of the products were evaluated on the basis of the percentage of reduction in mean egg count compared to the mean egg count per gram of feces. A significant ( $p < 0.01$ ) reduction of EPG (eggs per gram) count was found on 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup> and 28<sup>th</sup> day of treated goat of group A, B and C respectively.

The effects of three anthelmintics ivermectin, levamisole HCl and albendazole on TEC of goats for 28 days at 7 days interval was shown in (Table 2). The pre-

Table 2. Efficacy of ivermectin, levamisole HCl and albendazole on hematological parameters Total Erythrocyte Count (TEC)

Group	Treatment	Pre-treatment	Post-treatment							
		Day 0	Day 7		Day 14		Day 21		Day 28	
		Mean ±SE	Mean ±SE	%	Mean ±SE	%	Mean ±SE	%	Mean ±SE	%
G <sub>A</sub>	Inj. Vermic®	7.98±0.06	8.16±0.05**	2.21	8.14±0.05**	1.97	8.12±0.09**	1.72	8.10±0.05**	1.48
G <sub>B</sub>	Levavet®	8.06±0.05	8.10±0.07**	0.49	8.10±0.07**	0.49	8.12±0.06**	0.74	8.08±0.06**	0.25
G <sub>C</sub>	Almex-vet®	7.96±0.09	8.10±0.07**	1.73	7.98±0.08**	0.25	8.14±0.06**	2.21	8.24±0.06**	3.40
G <sub>D</sub>	Control group	7.90±0.08	7.84±0.04**	0.76	7.48±0.10**	5.32	7.56±0.06**	4.30	7.29±0.12**	7.72

\*\* = Significant at 1 percent level ( $p < 0.01$  and  $p > 0.05$ )

Table 3. Efficacy of ivermectin, levamisole HCl and albendazole on hematological parameters Hemoglobin (Hb %) in goat

Group	Treatment	Pre-treatment	Post-treatment							
		Day 0	Day 7		Day 14		Day 21		Day 28	
		Mean ±SE	Mean ±SE	%	Mean ±SE	%	Mean ±SE	%	Mean ±SE	%
G <sub>A</sub>	Inj. Vermic®	7.66±0.22	8.02±0.16**	4.49	8.36±0.09**	8.37	8.60±0.19**	10.93	8.82±0.25**	13.15
G <sub>B</sub>	Levavet®	7.56±0.21	8.04±0.21**	5.97	8.10±0.40**	6.67	8.58±0.19**	11.89	8.88±0.20**	14.86
G <sub>C</sub>	Almex-vet®	7.14±0.10	7.64±0.53**	6.54	8.10±0.51**	11.85	8.44±0.27**	15.40	9.04±0.36**	21.02
G <sub>D</sub>	Control group	7.22±0.12	7.62±0.25**	-5.54	7.60±0.29**	-5.26	8.02±0.24**	-11.08	7.58±0.21**	-4.99

\*\* = Significant at 1 percent level ( $p < 0.01$  and  $p > 0.05$ )

treatment values of TEC (million/cu. mm of blood) were  $7.98 \pm 0.06$ ,  $8.06 \pm 0.05$  and  $7.96 \pm 0.09$  in the goats of group A, B and C respectively. On the 28<sup>th</sup> day of the post-treatment, the mean values of TEC were increased up to  $8.10 \pm 0.05$ ,  $8.08 \pm 0.06$  and  $8.24 \pm 0.06$  in the goats of group A, B and C respectively. The mean value of TEC in control group (group D) was  $7.90 \pm 0.08$  but the mean values of TEC started to decrease on 28<sup>th</sup> day and recorded as  $7.29 \pm 0.12$ . The mean value of TEC was significantly increased ( $p < 0.01$  and  $p > 0.05$ ) on 28<sup>th</sup> day of the treatment of three anthelmintics. These results are more or less similar with the earlier researchers, Islam et al., (2003), Richard et al., (1990) and Preston and Allonby (1978) in goat.

The effects of three anthelmintics ivermectin, levamisole HCl and albendazole on Hemoglobin (Hb %) of goats for 28 days

at 7 days interval was shown in (Table 3). The pre-treatment values of Hb (g %) were  $7.66 \pm 0.22$ ,  $7.50 \pm 0.21$  and  $7.14 \pm 0.10$  in the goats of group A, B and C respectively. On the 28<sup>th</sup> day of the post-treatment, the mean values of Hb (g %) were increased up to  $8.82 \pm 0.25$ ,  $8.80 \pm 0.20$  and  $9.04 \pm 0.36$  in the goats of group A, B and C respectively. The mean value of Hb (g %) in control group (group D) was  $7.22 \pm 0.12$  but the mean values of Hb (g %) started to increase on 28<sup>th</sup> day and recorded as  $7.58 \pm 0.21$ . The mean value of Hb (g %) was significantly increased ( $p < 0.01$  and  $p > 0.05$ ) on 28<sup>th</sup> day of three anthelmintics treatment. Similar results have also been stated with the earlier researchers, Mukherjee (1992), Islam et al., (2003) and Yousif et al., (1988) in goat.

The effects of three anthelmintics ivermectin, levamisole HCl and albendazole on Packed Cell Volume (PCV %) of goats

Table 4. Efficacy of ivermectin, levamisole HCl and albendazole on hematological parameters Packed Cell Volume (PCV %) in goat

Group	Treatment	Pre-treatment	Post-treatment							
		Day 0	Day 7		Day 14		Day 21		Day 28	
		Mean $\pm$ SE	Mean $\pm$ SE	%	Mean $\pm$ SE	%	Mean $\pm$ SE	%	Mean $\pm$ SE	%
G <sub>A</sub>	Inj. Vermic®	27.10 $\pm$ 0.19	28.26 $\pm$ 0.09**	4.10	28.52 $\pm$ 0.18**	4.98	28.64 $\pm$ 0.11**	5.38	29.26 $\pm$ 0.09**	7.38
G <sub>B</sub>	Levavet®	27.13 $\pm$ 0.10	28.32 $\pm$ 0.21**	4.22	28.44 $\pm$ 0.19**	4.62	28.50 $\pm$ 0.20**	4.82	29.04 $\pm$ 0.13**	6.58
G <sub>C</sub>	Almex-vet®	27.30 $\pm$ 0.62	28.10 $\pm$ 0.22**	2.85	28.16 $\pm$ 0.06**	3.05	28.36 $\pm$ 0.13**	3.74	29.04 $\pm$ 0.05**	5.99
G <sub>D</sub>	Control group	27.37 $\pm$ 0.27	27.26 $\pm$ 0.09**	0.41	27.18 $\pm$ 0.12**	0.70	27.10 $\pm$ 0.12**	0.99	27.39 $\pm$ 0.06**	1.07

\*\* = Significant at 1 percent level ( $p < 0.01$  and  $p > 0.05$ )

Table 5. Efficacy of ivermectin, levamisole HCl and albendazole on hematological parameters Erythrocyte Sedimentation Rate ESR (mm h<sup>-1</sup>) in goat

Group	Treatment	Pre-treatment	Post-treatment							
		Day 0	Day 7		Day 14		Day 21		Day 28	
		Mean $\pm$ SE	Mean $\pm$ SE	%	Mean $\pm$ SE	%	Mean $\pm$ SE	%	Mean $\pm$ SE	%
G <sub>A</sub>	Inj. Vermic®	0.14 $\pm$ 0.02	0.04 $\pm$ 0.01*	71.01	0.00 $\pm$ 0.00*	100	0.00 $\pm$ 0.00*	100	0.00 $\pm$ 0.00*	100
G <sub>B</sub>	Levavet®	0.13 $\pm$ 0.01	0.03 $\pm$ 0.01*	73.02	0.00 $\pm$ 0.00*	100	0.00 $\pm$ 0.00*	100	0.00 $\pm$ 0.00*	100
G <sub>C</sub>	Almex-vet®	0.13 $\pm$ 0.01	0.04 $\pm$ 0.01*	71.25	0.00 $\pm$ 0.00*	100	0.00 $\pm$ 0.00*	100	0.00 $\pm$ 0.00*	100
G <sub>D</sub>	Control group	0.15 $\pm$ 0.01	0.21 $\pm$ 0.01*	29.81	0.31 $\pm$ 0.04*	52.90	0.65 $\pm$ 0.04*	77.68	1.12 $\pm$ 0.05*	86.96

\* = Significant at 5 percent level ( $p < 0.05$  and  $p > 0.01$ )

for 28 days at 7 days interval was shown in (Table 4). The pre-treatment values of PCV were 27.10 $\pm$ 0.19, 27.13 $\pm$ 0.10 and 27.30 $\pm$ 0.62 in the goats of group A, B and C respectively. On the 28<sup>th</sup> day of the post-treatment, the mean values of PCV were increased up to 29.26 $\pm$ 0.09, 29.04 $\pm$ 0.13 and 29.04 $\pm$ 0.05 in the goats of group A, B and C respectively. The mean value of PCV in control group (group D) was 27.37 $\pm$ 0.27 but the mean values of PCV started to increase on 28<sup>th</sup> day and recorded as 27.39 $\pm$ 0.06. The mean value of PCV was significantly increased ( $p < 0.01$  and  $p > 0.05$ ) on 28<sup>th</sup> day of three anthelmintics treatment. This result has are more or less similar with the report of Nettleton and Beckett (1976) declined PCV value was observed in control group. Similar results have also been stated by the

earlier workers Islam et al., (2003) and Tariq et al., (2010).

The effects of three anthelmintics ivermectin, levamisole HCl and albendazole on Erythrocyte Sedimentation Rate ESR (mm h<sup>-1</sup>) of goats for 28 days at 7 days interval was shown in (Table 5). The initial control values of ESR (mm h<sup>-1</sup>) were 0.14 $\pm$ 0.02, 0.13 $\pm$ 0.01 and 0.13 $\pm$ 0.01 in the goats of group A, B and C respectively. On the 28<sup>th</sup> day of the post-treatment, the mean values of ESR (mm h<sup>-1</sup>) were decreased up to 0.00 $\pm$ 0.00, 0.00 $\pm$ 0.00 and 0.00 $\pm$ 0.00 in the goats of group A, B and C respectively. The mean value of ESR (mm h<sup>-1</sup>) in control group (group D) was 0.15 $\pm$ 0.01 but the mean values of ESR (mm h<sup>-1</sup>) started to increase on 28<sup>th</sup> day and recorded as 1.12 $\pm$ 0.05. The mean value of ESR (mm h<sup>-1</sup>)

Table 6. Efficacy of ivermectin, levamisole HCl and albendazole on hematological parameters Total Leukocyte Count (TLC) in goat

Group	Treatment	Pre-treatment	Post-treatment							
		Day 0	Day 7		Day 14		Day 21		Day 28	
		Mean $\pm$ SE	Mean $\pm$ SE	%	Mean $\pm$ SE	%	Mean $\pm$ SE	%	Mean $\pm$ SE	%
G <sub>A</sub>	Inj. Vermic®	8.12 $\pm$ 0.04	7.84 $\pm$ 0.08*	3.45	7.84 $\pm$ 0.05*	3.45	7.98 $\pm$ 0.07*	1.72	7.92 $\pm$ 0.06*	2.18
G <sub>B</sub>	Levavet®	8.12 $\pm$ 0.06	7.94 $\pm$ 0.08*	2.22	7.92 $\pm$ 0.07*	2.46	7.94 $\pm$ 0.06*	2.22	7.96 $\pm$ 0.07*	1.97
G <sub>C</sub>	Almex-vet®	8.24 $\pm$ 0.05	7.88 $\pm$ 0.04*	4.37	7.98 $\pm$ 0.06*	3.16	8.00 $\pm$ 0.05*	2.91	8.06 $\pm$ 0.04*	2.46
G <sub>D</sub>	Control group	8.06 $\pm$ 0.04	8.08 $\pm$ 0.05*	0.25	8.10 $\pm$ 0.07*	0.49	8.14 $\pm$ 0.05*	0.98	8.22 $\pm$ 0.07*	1.95

\* = Significant at 5 percent level ( $p < 0.05$  and  $p > 0.01$ )

Table 7. Efficacy of ivermectin, levamisole HCl and albendazole on body weight (kg) gain/loss in goat

Groups	Treatment	Pretreatment	Post-treatment		Bodyweight of individual goat (kg)	Mean (%)
		Day 0	Day 28			
		Body weight (kg)	Body weight (kg)	% change		
G <sub>A</sub>	Inj. Vermic®	14.38 $\pm$ 0.16	14.68 $\pm$ 0.14**	2.04	+3.20	+2.64
G <sub>B</sub>	Levavet®	14.44 $\pm$ 0.14	14.58 $\pm$ 0.18**	0.96	+2.80	+2.46
G <sub>C</sub>	Almex- vet®	14.34 $\pm$ 0.09	15.32 $\pm$ 0.40**	6.40	+3.60	+3.04
G <sub>D</sub>	Control group	14.30 $\pm$ 0.05	14.30 $\pm$ 0.03**	0.00	-1.60	-1.35

\*\* = Significant at 1 percent level ( $p < 0.01$  and  $p > 0.05$ )

was significantly decreased ( $p < 0.05$  and  $p > 0.01$ ) on 28<sup>th</sup> days of treatment. This result is similar to the reports of Gillespie et al., (2010), Rehman et al., (2009) and Ram et al., (2007).

The effects of three anthelmintics ivermectin, levamisole HCl and albendazole on Total Leukocyte Count (TLC) of goats for 28 days at 7 days interval was shown in (Table 6). The pre-treatment values of TLC were 8.12 $\pm$ 0.04, 8.12 $\pm$ 0.06 and 8.24 $\pm$ 0.05 in the goats of group A, B and C respectively. On the 28<sup>th</sup> day of the post-treatment, the mean values of TLC were decreased up to 7.79 $\pm$ 0.03, 8.10 $\pm$ 0.09 and 7.95 $\pm$ 0.08 in the goats of group A, B and C respectively. The mean value of TLC in control group (group D) was 8.06 $\pm$ 0.04 but the mean values of TLC started to increase on 28<sup>th</sup> day and recorded as 8.22 $\pm$ 0.07. The mean value of TLC was significantly decreased ( $p < 0.05$  and  $p > 0.01$ ) on 28<sup>th</sup> days of treatment. These present findings in agreement of the works with Richard et al., (1990), Windon (1990) and Preston and Allonby (1978) in goat,

Yousif et al., (1988), Preston and Allonby (1978) and Gray et al., (1987) in sheep.

The mean initial body weight on day '0' of goats in group A, B and C were 14.38 $\pm$ 0.16, 14.44 $\pm$ 0.14 and 14.34 $\pm$ 0.09 kg respectively. On the 28<sup>th</sup> day of the post-treatment, the mean values of body weight were increased up to 14.68 $\pm$ 0.14, 14.58 $\pm$ 0.18 and 15.32 $\pm$ 0.40 in the goats of group A, B and C respectively. The body weight increased significantly ( $P < 0.01$ ) after treatments in group A, B and C. The body weight was increased and this may be due to removal of parasitic load, proper absorption and metabolism of nutrient in the parasite free gastrointestinal tract. The body weight gains in the ivermectin, levamisole and albendazole treated goat are supported by Isles et al (1985) in heifers. On the other hand, the body weight significantly decreased in untreated control group due to overload of parasites within the body of goat. The improvement percentage in goats of group A, B and C after 28<sup>th</sup> day was 2.04%, 0.96% and 6.40% respectively. In

the control group (group D) body weight was reduced to the extent of -1.35% after 28<sup>th</sup> day (Table 7). Some earlier workers found improvement in body weight after treatment Pandit *et al.*, (2009), Chand-Thakuri *et al.*, (1994), Zajac *et al.*, (1992), Rossanigo *et al.*, (1993) and Thedford *et al.*, (1990).

During the study of hematological parameters it was found that after treatment with Vermic (Ivermectin 1%, injectable formulation), Levavet (Levamisole HCl) and Almex-Vet (Albendazole) TEC, Hb and PCV were significantly ( $p < 0.01$  and  $p > 0.05$ ) increased and on the other hand, ESR and TLC was significantly ( $p < 0.05$  and  $p > 0.01$ ) decreased in treated groups (Table 2-6). The mean value of Hb, PCV and TEC were decreased and ESR, TLC values were increased in untreated naturally parasitized control group. This study indicated that Almex-Vet (Albendazole) is a more effective drug against gastrointestinal nematodiasis in goats than that of Vermic (injectable Ivermectin) and Levavet (Levamisole HCl).

## CONCLUSION

The findings of the present study reveal that *Haemonchus* spp, *Trichostrongylus* spp, *Cooperia* spp, *Oesophagostomum* spp, *Trichuris* spp, *Strongyloides* spp and mixed infections are prevalent in Bangladesh. Ivermectin (Vermic, injectable formulation), Levamisole (Levavet) and Albendazole (Almex-Vet) are effective for the reduction of EPG (eggs per gram) of gastrointestinal nematodes. This study indicated that Almex-Vet (Albendazole) are highly effective on egg count EPG (eggs per gram) and hematological parameters (TEC, Hb, PCV, ESR and TLC) in gastrointestinal nematodiasis in goats than that of Vermic (injectable Ivermectin) and Almex-Vet (Albendazole) during the experiment. These three anthelmintics have wide therapeutic index and are capable of killing or inhibiting egg production of gastrointestinal nematodes. The findings of the present study may help the future researchers to explore the details pharmacokinetic and toxic effects, for wide therapeutic uses in Bangladesh for the treatment and control of

parasitic infection in goat. Further studies are required to clarify the efficacy of the anthelmintics widely used in different agro ecologies, animal species and livestock management systems in Bangladesh. From these research findings the veterinarian may use the specific anthelmintics for gastrointestinal nematodiasis in goats. Further studies on anthelmintics pharmacokinetic and toxicity would be helpful.

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