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EFFECTS OF THREE DIFFERENT MODERN ANTHELMINTIC AGAINST GASTROINTESTINAL NEMATODIASIS IN BLACK BENGAL GOATS

***Md. Aktaruzzaman[1,2], Md. Anwar Hossain[2]**
[1]*Pharmacogenomics Lab, Department of Pharmacology, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia*
[2]*Department of Pharmacology and Toxicology, Faculty of Veterinary and Animal Science, Sylhet Agricultural University, Sylhet-3100, Bangladesh*

Corresponding author:- drmazaman84sau@gmail.com

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 50 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 14-16 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-1 body weight, S/C) preparations (Techno Drugs Limited, Bangladesh) and two solid levamisole HCl, albendazole (7.5 mgkg-1 body weight, orally) preparations (Techno Drugs Limited 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 7th, 14th, 21st and 28th day using McMaster fecal egg counting method. Body weight were recorded on day 28 following the treatments. The results of the comparative efficacies of different anthelmintic of ivermectin was 83.25%, followed by levamisole HCl 94.53% and albendazole 86.12%. McMaster fecal egg counting method disclose 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 words: Comparative efficacy, anthelmintic, EPG, 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". 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 ca. 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; Sahlu 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 oxyclozanide 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 A-mectin® (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 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 Pharmacology and Toxicology, Sylhet Agricultural University, Sylhet. Sylhet Government Goat Development farm, Sylhet was selected for this study. The research was carried out during the period of July to December, 2013. The following procedures were adopted for performing the experiment. Twenty goats of 14-16 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.

Blood and fecal samples were collected from each goat and after prescribing a proper identification tag it and was immediately brought to the Pharmacology and Toxicology Laboratory, Sylhet, Bangladesh for fecal examination. Weekly EPG count was done on day 7^{th}, 14th, 21st, 28th 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^{th}, 14^{th}, 21^{st}

and 28th during experimental period. The hematological parameters were examined in the laboratory of the Department of Pharmacology and Toxicology, Sylhet, Bangladesh. Live weight gain of each group on recorded on day 1 and 28 using digital weight balance.

Goats of group A were treated with A-mectin injection (Ivermectin 1%, The ACME Laboratories Ltd, Bangladesh) subcutaneously at the dose rate of 200µgkg^{-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 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 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 7th, 14th, 21st and 28th 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). The eggs of parasites were identified on the basis of morphological characteristics as described by Soulsby (1986) and then counted.

RESULTS AND DISCUSSION

Effects of ivermectin, levamisole HCl and albendazole on egg per gram (EPG) in gastrointestinal nematodiasis in goats. 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 count before treatment 290.25±5.67 and after treatment mean EPG on 7th, 14th, 21st and 28th day were 72.95±0.76, 85.77±3.69, 63.35±1.39, and 41.77±3.58 respectively. The rate of reduction of mean EPG on 7th, 14th, 21st and 28th day after treatment were 83.25%. 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 work was carried out previously to determine the efficacy of this anthelmintics in Bangladesh. It occurred due to the potency of different anthelmintic against gastrointestinal nematodiasis in goats. This study revealed that ivermectin is a most effective anthelmintics against gastrointestinal nematodiasis in goats.

In treatment group B, the pre-treatment mean EPG count was 322.45±7.15 and the post-treatment mean EPG count values at 7th, 14th, 21st and 28th day were 84.32±2.25, 63.45±3.45, 43.45±4.50, and 20.45±1.23 respectively. The rate of reductions were significantly increased to the extent of mean EPG on 7th, 14th, 21st and 28th day after treatment were 94.53%. The result is more or less similar by earlier reported Beck *et al.*, (1971); Sharma and Jagadish (1991); Prodhan *et al*., (1993); Thejeomooethy *et al.*, (1995); Vesconcelos *et al.*, (1995) and Williams and Broussared (1995). Haq *et al.*, (1984) reported that levamisole at the dose rate of 8.5 mgkg^{-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 count was 320.52±17.15 and the post-treatment mean EPG count values at 7th, 14th, 21st and 28th day were 45.87±3.15, 55.45±3.05, 47.23±1.65, and 40.75±0.76 respectively. The rate of reductions were significantly increased to the extent of mean EPG on 7th, 14th, 21st and 28th 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 rafoxanide 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 count was 298.05±5.86 and on the EPG count values at 7th, 14th, 21st and 28th day were 302.25±2.27, 305.05±2.53, 307.52±3.45 and 310.52±1.27 respectively and the rate of EPG 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 count was found on 7th, 14th, 21st and 28th 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-treatment values of TEC (million/cu. mm of blood) were 8.11±0.07, 8.05±0.09 and 8.09±0.03 in the goats of group A, B and C respectively. On the 28th day of the post-treatment, the mean values of TEC were increased up to 8.25±0.08, 8.45±0.09 and 8.35±0.09 in the goats of group A, B and C respectively. The mean value of TEC in control group (group D) was 8.92±0.07 but the mean values of TEC started to decrease on 28th day and recorded as 8.32±0.12. The mean value of TEC was significantly increased ($p>0.05$ and $p<0.01$) on 28th 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 pre-treatment values of Hb (g %) were 7.50±0.25, 7.52±0.15 and 7.45±0.25 in the goats of group A, B and C respectively. On the 28th day of the post-treatment, the mean values of Hb (g %) were increased up to 8.97±0.29, 9.53±0.39 and 8.95±0.29 in the goats of group A, B and C respectively. The mean value of Hb (g %) in control group (group D) was 7.12±0.13 but the mean values of Hb (g %) started to increase on 28th day and recorded as 7.57±0.29. The mean value of Hb (g %) was significantly increased ($p>0.05$ and $p<0.01$) on 28th 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 pre-treatment values of PCV were 27.88±0.15, 27.95±0.69 and 27.93±0.29 in the goats of group A, B and C respectively.

Table 1. Effects of three different modern anthelmintic on egg count (EPG) in goats

Groups	Treatment	Pre-treatment	Post-treatment				
		Day 0	Day 7	Day 14	Day 21	Day 28	% Reduction at day "28"
G_A	Inj. A-mectin(R)	290.25 ± 5.67	72.95 ± 0.76**	85.77 ± 3.69**	63.35 ± 1.39**	41.77 ± 3.58**	83.25
G_B	Levavet(R)	322.45 ± 7.15	84.32 ± 2.25**	63.45 ± 3.45**	43.45 ± 4.50**	20.45 ± 1.23**	94.53
G_C	Almex- vet(R)	320.52 ± 17.15	45.87 ± 3.15**	55.45 ± 3.05**	47.23 ± 1.65**	40.75 ± 0.76**	86.12
G_D	Control group	298.05 ± 5.86	302.25 ± 2.27**	305.05 ± 2.53**	307.52 ± 3.45**	310.52 ± 1.27**	5.07

** = Significant at 1 percent level ($p<0.01$)

On the 28th day of the post-treatment, the mean values of PCV were increased up to 29.45±0.18, 30.15±0.12 and 29.95±0.38 in the goats of group A, B and C respectively. The mean value of PCV in control group (group D) was 27.77±0.25 but the mean values of PCV started to increase on 28th day and recorded as 27.58±0.04. The mean value of PCV was significantly increased ($p>0.05$ and $p<0.01$) on 28th day of three anthelmintics treatment. This results have 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 initial control values of ESR (mm h^{-1}) were 0.18±0.07, 0.14±0.02 and 0.19±0.05 in the goats of group A, B and C respectively. On the 28th day of the post-treatment, the mean values of ESR (mm h^{-1}) were increased up to 0.00±0.00, 0.00±0.00 and 0.00±0.00 in the goats of group A, B and C respectively. The mean value of ESR (mm h^{-1}) in control group (group D) was 0.13±0.04 but the mean values of ESR (mm h^{-1}) started to increase on 28th day and recorded as 1.29±0.00. The mean value of ESR (mm h^{-1}) was significantly decreased ($p<0.05$ and $p>0.01$) on 28th days of treatment. This results is similar to the reports of Gillespie et al., (2010), Rehman et al., (2009) and Ram et al., (2007).

The pre-treatment values of TLC were 7.84±0.04, 8.45±0.09 and 7.86±0.05 in the goats of group A, B and C respectively. On the 28th day of the post-treatment, the mean values of TLC were increased up to 7.79±0.03, 8.10±0.09 and 7.95±0.08 in the goats of group A, B and C respectively. The mean value of TLC in control group (group D) was 8.07±0.08 but the mean values of TLC started to increase on 28th day and recorded as 8.25±0.10. The mean value of TLC was significantly decreased ($p<0.05$ and $p>0.01$) on 28th 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 14.86±0.12, 14.95±0.08 and 14.59±0.18 kg respectively. On the 28th day of the post-treatment, the mean values of body weight were increased up to 15.87±0.19, 16.91±0.48 and 15.69±0.17 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

Table 2. Hematological findings of control and study groups at day 28 post treatment

Groups	Treatment	Pre-treatment					Post-treatment				
		Day 0					Day 28				
		TEC	Hb	PCV	ESR	TLC	TEC	Hb	PCV	ESR	TLC
G_A	Inj. A-mectin(R)	8.11 ± 0.07	7.50 ± 0.25	27.88 ± 0.15	0.18 ± 0.07	7.84 ± 0.04	8.25 ± 0.08**	8.97 ± 0.29**	29.45 ± 0.18*	0.00 ± 0.00	7.79 ± 0.03**
G_B	Levavet(R)	8.05 ± 0.09	7.52 ± 0.15	27.95 ± 0.69	0.14 ± 0.02	8.45 ± 0.09	8.45 ± 0.09**	9.53 ± 0.39**	30.15 ± 0.12*	0.00 ± 0.00	8.10 ± 0.09**
G_C	Almex-vet(R)	8.09 ± 0.03	7.45 ± 0.25	27.93 ± 0.29	0.19 ± 0.05	7.86 ± 0.05	8.35 ± 0.09**	8.95 ± 0.29**	29.95 ± 0.38*	0.00 ± 0.00	7.95 ± 0.08**
G_D	Control group	8.92 ± 0.07	7.12 ± 0.13	27.77 ± 0.25	0.13 ± 0.04	8.07 ± 0.08	8.32 ± 0.12**	7.57 ± 0.29**	27.58 ± 0.04*	1.29 ± 0.01	8.25 ± 0.10**

TEC = Total erythrocytes count; Hb = Hemoglobin; PCV = Packed cell volume; ESR = Erythrocyte Sedimentation Rate; TLC = Total leukocyte count; SE = Standard Error

** = Significant at 1 percent level ($p<0.01$); * = Significant at 5 percent level ($p<0.05$)

Table 3. Effects on different anthelmintics on bodyweight (kg) gain/loss of goat in various treatment days

Groups	Treatment	Pretreatment	Post-treatment		Bodyweight of individual goat (kg)	Mean (%)
		Day 0	Day 28			
		Body weight (kg)	Body weight (kg)	% change		
G_A	Inj. A-mectin$^{(R)}$	14.86±0.12	15.87±0.19**	7.02	+3.27	+3.35
G_B	Levavet$^{(R)}$	14.95±0.08	16.91±0.48**	14.93	+2.89	+3.98
G_C	Almex- vet$^{(R)}$	14.59±0.18	15.69±0.17**	9.44	+3.62	+3.03
G_D	Control group	14.35±0.02	14.15±0.01**	-0.90	-1.63	-1.39

** = Significant at 1 percent level ($p<0.01$)

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 28th day was 7.02%, 14.93% and 9.44% respectively. The body weight almost similar to their pre-treatment values. In the control group (group D) body weight was reduces to the extent of -0.90% after 28th day (Table 3). 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 A-mectin (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). 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 Levavet (Levamisole HCl) is a more effective drug against gastrointestinal nematodiasis in goats than that of A-mectin (injectable Ivermectin) and Almex-Vet (Albendazole).

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 (A-mectin, injectable formulation), Levamisole (Levavet) and Albendazole (Almex-Vet) are effective for the reduction of EPG of gastrointestinal nematodes. This study indicated that Levavet (Levamisole HCl) are highly effective on egg count (EPG) and hematological parameters (TEC, Hb, PCV, ESR and TLC) in gastrointestinal nematodiasis in goats than that of A-mectin (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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