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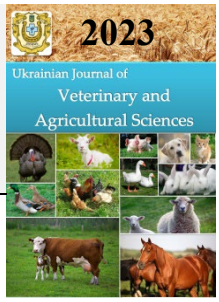

Drug potency effects of three anthelmintics against natural fascioliasis with hematological values in goat

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Contents

Abstract

The purpose of the study was to compare the effectiveness of three anthelmintics against naturally occurring fascioliasis in goats as well as how they affected various hematological values over the course of 28 days. For this investigation, out of 417 goats, 60 were selected who were suffering from liver fluke infection. After being randomly divided into four groups of 15 animals each, the first three groups got treatment with triclabendazole, oxyclozanide, and nitroxynil while the fourth group was kept as a control group and received no medication. The results of the study showed that the egg per gram (EPG) count of the treatment groups significantly decreased successively ($P < 0.01$) on days 3rd, 7th, 14th, and 28th, whereas the control group produced significantly from day 3rd through the experimental period. Results revealed that the mean EPG was reduced by 78.40 %, 73.33 %, and 83.11 %, respectively, following treatment with triclabendazole, oxyclozanide, and nitroxynil, while the mean EPG production was 22.66 % in the control group. Hematological parameters including Hb, PCV, and TEC values, were lower before the treatment but turned to increase significantly ($P < 0.01$) on study day 28th, however, the mean TLC values were decreased substantially ($P < 0.01$) compared to the untreated control group. This result may indicate that all three anthelmintics were efficient, but nitroxynil had a relatively higher efficacy against goat fascioliasis regarding on the EPG and hematological indices.

Keywords: Fascioliasis; Hematology; Nitroxynil; Oxyclozanide; Triclabendazole.

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1. Introduction

Bangladesh is predominantly an agro-based developing nation where livestock, a sub-sector of agriculture, plays a vital role in accelerating the economic growth as well as food security of this exceptionally populated country (BBS, 2018). In Bangladesh, 83.9 % of total households possess livestock (animals or poultry or both), where around 45.9 % of families having ruminants-like stacks and 76.3 per cent having poultry reported by Banglapedia – the National Encyclopedia of Bangladesh (2012). On average, each household owns 0.81 bovine animals, 0.56 goats and sheep, and 7.23 chickens and ducks respectively. Roughly 18.8 million goats are reared by rural farmers in backyard systems (BBS, 2019) simply because they are more prolific, can have two or more kids per birth, produce high quality meat and milk, and have excellent quality of skin (Rahman et al., 2014). Therefore, improving the socio-economic status, income and livelihood of poor backyard farmers through goat rearing plays an inevitable role in Bangladesh (Hossain et al., 2017).

Parasitism is a global problem both for small and large farmers, which posing a serious threat to the livestock industry (Saddiqi et al., 2010) and is believed to be one of the main factors constraining in rural goat production in Bangladesh (Hassan et al., 2012). The importance of helminth contamination has been multiplied several times in third world like Bangladesh, where the human economy is heavily dependent on their livestock (Bhowmik et al., 2020; Mia et al., 2022). However, Bangladesh's hot, humid climate and poor farming practices provide certain favorable environmental conditions for the rapid growth, multiplication, and spread of several pests and parasites (Rahman et al., 2014). In addition, heavy precipitation in the summer and autumn, deep fog during the cold season of the year and also low-

lying areas may lead to higher prevalence of diseases in Bangladesh (Al Mamun et al., 2011; Rahman et al., 2017).

Fasciola species, which infest 10 to 32 % of goats in Bangladesh and cause both acute and chronic infections (Shykat et al., 2022), are one of the most significant parasites among all helminths due to their vast range of specific hosts, including cattle, buffalo, sheep, goats, and humans (Rondelaud et al., 2001; Rahman et al., 2017). This results in a mortality rate of about 10 % for sheep and goats and 5 % for cattle and buffaloes in Bangladesh (BLRI, 2006). So both domestic and wild ruminants, fascioliasis is a serious and well-known veterinary disease that results in large economic losses to the livestock industry due to animal deaths, growth retardation, milk reduction, infertility, the obliteration of affected livers, and excessive costs associated with treatment measures (Malone et al., 1998; Rahman et al., 2017; Mia et al., 2022). When *F. hepatica* or *F. gigantica*, the cause of fascioliasis, mature, they migrate throughout the liver parenchyma and tissue and consume the blood of the ultimate host at a rate of 0.2 to 0.5 mL per day per fluke, resulting in severe anemia (Wiedosari et al., 2006), considerable blood loss and all other associated adverse effects (Soun et al., 2006).

Thus, the aim of this study was to evaluate the efficacy of triclabendazole, oxyclozanide, and nitroxenil which were provided free of charge by the local government veterinary hospital against goats infected with fascioliasis in local household farms. In this current investigation, their effectiveness were measured on the basis of EPG count and hematological parameters including hemoglobin (Hb), packed cell volume (PCV), total erythrocyte count (TEC), and total leukocyte count (TLC). The results of this study may therefore be useful for goat rearing with effective parasitic treatment under backyard systems across the world.

2. Materials and methods

Experimental area

The experiment was conducted at the adjacent household farms near to the Upazilla Livestock Office and Veterinary Hospital in Naldanga Upazilla, District Natore, Bangladesh, which is situated at 24° 30' 0" north, 88° 57' 0" east (Fig. 1). This research was carried out from May to October 2020 and during that time Climate & Weather Averages in Natore S, Bangladesh (2020) reported an average rainfall of 196.75 mm, with a range of 46.7 to 264.6 mm. The main features of the climate in this area are mainly rainy summer, wet autumn and dry winter. Geologically the land possesses marshy areas which are suitable for snails, the intermediate host of *Fasciola spp*.

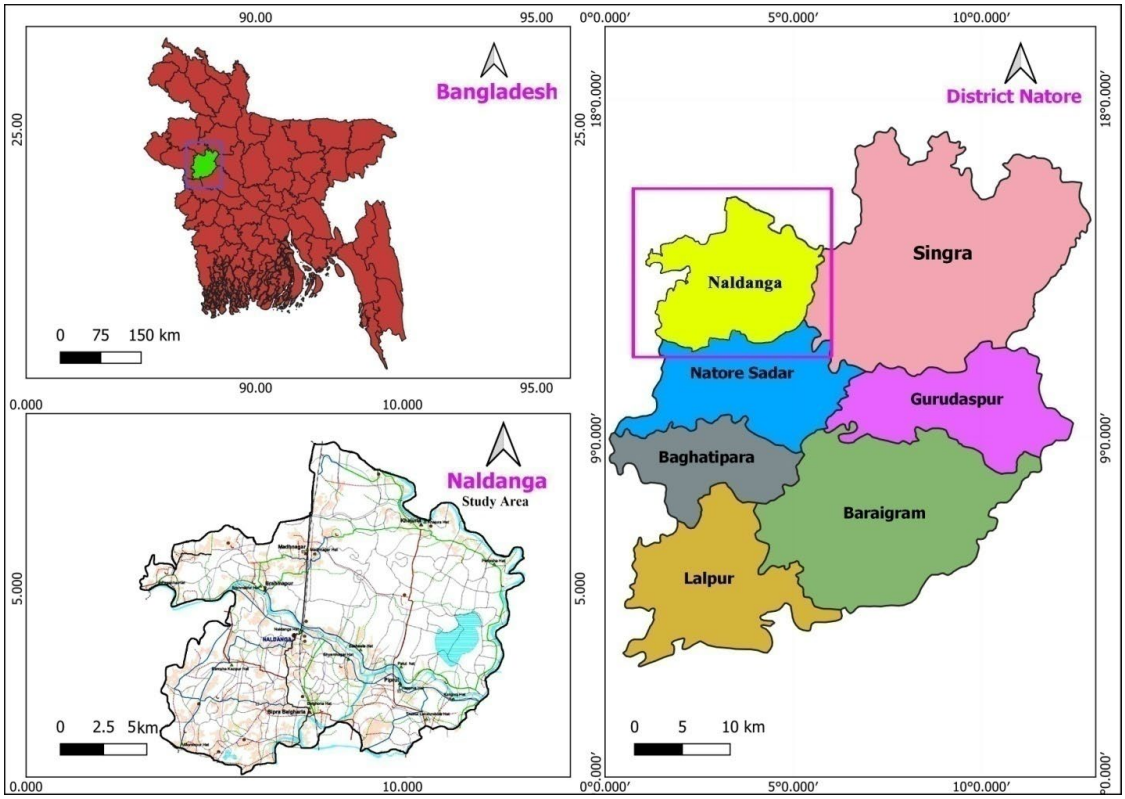

Fig. 1. Location of study area (Naldanga) in District Natore, Bangladesh

Experimental animals

A total of 40 household farms with 417 goats each were random selected for this investigation, with each farm having at least 3 to 15 goats with an average age of 6 months. Goats with poor body condition, a history of diarrhea, and severe anemia were suspected of having a parasitic infection and screened for the presence of parasitic ova. Goats those having with Fasciola infection and more than 100 eggs per gm of fecal sample were included to evaluate the effect of anti-parasitic drugs potency. Therefore, all 60 goats that tested positive for parasites were used in field anthelmintic trial for a period of 28 days and were randomly divided into four groups (Group A, B, C, and D) with 15 goats in each group. Group wise detailed anthelmintic treatment schedule is presented in Table 1. The farmer's consent was taken before starting of the study.

Table 1
Treatment protocols to evaluate the efficacy of various anthelmintics against fasciolosis in goat

Treatment groups	Drugs detail						
	Number of animals	Generic name	Trade name	Company name	Dose/kg BW	R/A	F/A
A	15	Triclabendazole	Fasinex®	Novartis Bangladesh Ltd.	12 mg	Oral	Once
B	15	Oxyclozanide	Tremacid®	Renata Animal Health Ltd.	15 mg	Oral	Once
C	15	Nitroxynil	Nitronex®	Renata Animal Health Ltd.	10 mg	S/C	Once
D	15	Control group	(No treatment)				

BW: body weight; R/A: route of administration; F/A: Frequency of administration; and S/C: subcutaneous.

Sample collection and processing

Feces and whole blood samples were collected from goats of all treated groups on the 3rd, 7th, 14th, and 28th days of treatment. Fresh fecal samples were taken directly from the rectum of goats and immediately kept in plastic containers with 10 % formalin for preservation until used for examination. For the most accurate identification, a qualitative examination was performed for the presence of parasite eggs or oocysts under a microscope (×10 magnifications), these samples immediately were brought to the Upazilla Livestock Office and Veterinary Hospital in Naldanga, Natore. Within 48 hours of collection, fecal samples were subjected to quantitative testing for *Fasciola spp.* by using a modified McMaster's approach to measure EPG (Khan et al., 2017). 5 ml of blood from each goat's jugular vein was taken by using a sterile syringe and needle to maintain an aseptic environment and sent to the laboratory of FDIL, Jaypurhat at 4 °C in pre-cooled ice-box for hematological analysis. The blood samples were kept in vials with anticoagulant (sodium-EDTA) according to standard procedure on the days of 0th, 14th, and 28th during the experimental period as previously described by Coffin (1995).

Statistical analysis

Data were statistically analyzed by statistical package programmed MSTAT-C developed by Russel (1996). Significant differences were determined by using one-way ANOVA test for variance analysis at $P < 0.01$ and $P < 0.05$.

The efficacy of anthelmintics was evaluated based on the following formula (Varady et al., 2004):

$$\text{Percentage (\%) of drug efficacy} = \frac{P - R}{P} \times 100$$

Where, R = Average number of parasite eggs in one gram of fecal sample after treatment, P = Average number of parasite eggs in one gram of fecal sample before treatment.

3. Results and discussion

3.1. Results

Effects of triclabendazole, oxyclozanide, and nitroxynil on egg count per gram (EPG) of feces

The results of drug potency effects of triclabendazole, oxyclozanide, and nitroxynil against goat liver fluke infection (fascioliasis) are shown in Table 2. On the 3rd, 7th, l4th, and 28th days after starting treatment, groups A, B, and C, respectively, showed a significant ($P < 0.01$) decrease in EPG count. However, from the 3rd day onwards up till the study period, the EPG count of an untreated control group (Group D) was substantially ($P < 0.01$) increased. The mean EPG count in treatment group A was 228.48±1.89 before treatment and on the 3rd, 7th, l4th, and 28th days following treatment with triclabendazole, it was 88.66 ± 1.94, 69.68 ± 5.47, 59.85 ± 2.70, and 49.34 ± 2.30, respectively. The mean EPG count in treatment group B was 219.49 ± 0.45 before treatment and 96.60 ± 1.89, 78.72 ± 4.48, 66.46 ± 2.53, and 58.53 ± 2.83 after treatment with oxyclozanide on the 3rd, 7th, l4th, and 28th days, respectively. In treatment group C, the mean EPG count before treatment was 231.76±2.14 and after treatment with nitroxynil on 3rd, 7th, 14th, and 28th days were 77.13 ± 3.34, 65.28 ± 3.54, 51.53 ± 2.83, and 39.14 ± 3.41, respectively. After 28th days of treatment, there was a considerable rise in the rates of mean EPG count reduction, which were about 78.40 %, 73.33 %, and 83.11 % respectively, in three treated groups (Group A, B, and C) (Fig. 2). On the other hand, the mean EPG count in the untreated control group (Group D) was 221.46 ± 4.67 on the pre-treatment day and 227.54 ± 18.10, 239.96 ± 21.56, 256.83 ± 33.36, and 271.65 ± 19.82 on the 3rd, 7th, 14th, and 28th days, respectively. As a result, the mean EPG count increased significantly at a rate of about 22.66% on day 28th following therapy.

Table 2
Effects of Triclabendazole, Oxyclozanide, and Nitroxynil on egg per gram (EPG) of feces count

Groups	Pre-treatment	Post-treatment							
		3rd day		7th day		14th day		28th day	
		EPG	% Reduction	EPG	% Reduction	EPG	% Reduction	EPG	% Reduction
A	228.48 ± 1.89	88.66 ± 1.94**	61.19	69.68 ± 5.47**	69.50	59.85 ± 2.70**	73.80	49.34 ± 2.30**	78.40
B	219.49 ± 0.45	96.60 ± 1.89**	55.99	78.72 ± 4.48**	64.13	66.46 ± 2.53**	69.72	58.53 ± 2.83**	73.33
C	231.76 ± 2.14	77.13 ± 3.34**	66.72	65.28 ± 3.54**	71.83	51.53 ± 2.83**	77.76	39.14 ± 3.41**	83.11
Group	Pre-treatment	EPG	% Production	EPG	% Production	EPG	% Production	EPG	% Production
D	221.46 ± 4.67	227.54 ± 18.10**	2.74	239.96 ± 21.56**	8.35	256.83 ± 33.36**	15.97	271.65 ± 19.82**	22.66

The above values represent the mean ± standard deviation (SD) of each four groups
** = Significant at ($P < 0.01$)
Note: EPG= Eggs per Gram.

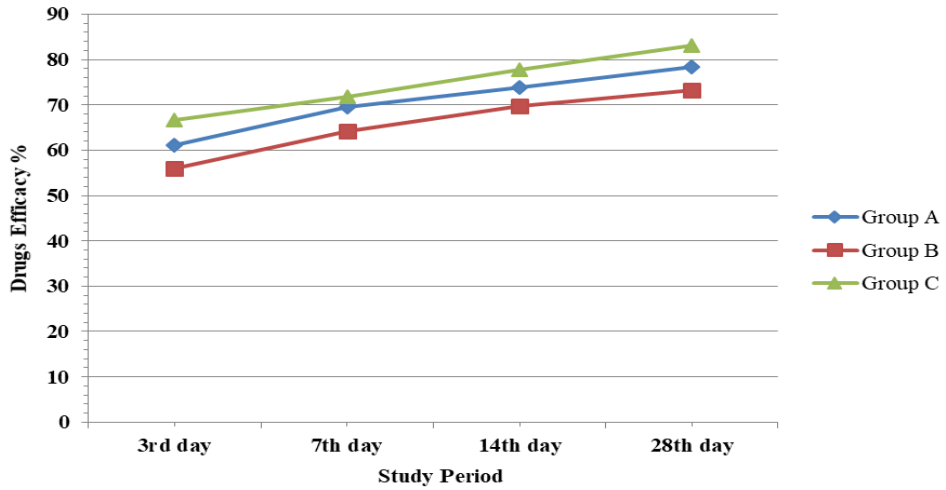

Fig. 2. Drugs efficacy rate (%) among three treated groups (A, B, and C)

Effects of Triclabendazole, Oxyclozanide, and Nitroxynil on hematological parameters

Table 3 compares the effectiveness of triclabendazole, oxyclozanide, and nitroxynil against liver fluke infection (fascioliasis) in goats based on various hematological markers. After receiving treatments with triclabendazole, oxyclozanide, and nitroxynil, groups A, B, and C showed significantly higher hemoglobin (Hb) (gm%) values ($P < 0.01$) than the untreated control group. Before therapy, the mean Hb (gm%) values in groups A, B, and C were 6.49 ± 0.40, 6.69 ± 0.57, and 6.32 ± 0.78 respectively; after treatment with triclabendazole, oxyclozanide, and nitroxynil on days 14th and 28th, the values were 8.76 ± 0.34 and 9.24 ± 0.32, 9.24 ± 0.32 and 9.56 ± 0.46, and 9.80 ± 0.28 and 10.38 ± 0.51, respectively. Whereas the mean Hb (gm%) concentrations of an untreated control group (Group D) before treatment were 6.78 ± 0.15 and on 14th and 28th days were 7.09 ± 0.17 and 6.59 ± 0.23, respectively.

After treatment with three commercial anthelmintics in groups A, B, and C as opposed to the untreated control group, the PCV (%) was significantly ($P < 0.01$) elevated. The mean PCV (%) following treatment in groups A, B, and C was, respectively, 27.48 ± 0.48, 23.90 ± 0.91, and 26.32 ± 0.58. The mean PCV (%) for Groups A, B, and C on the 14th and 28th days were 28.28 ± 0.36 and 28.60 ± 1.17, 24.78 ± 0.80 and 26.62 ± 1.02, 27.86 ± 0.46 and 29.16 ± 0.71, respectively. While the mean PCV (%) of an untreated control group (Group D) was 26.84 ± 0.40 before treatment, it was 24.78 ± 0.79 and 25.10 ± 0.39 on the 14th and 28th days, respectively.

In addition, triclabendazole, oxyclozanide, and nitroxynil therapy significantly ($P < 0.01$ and $P < 0.05$) raised the TEC (x106/cu.mm) values in groups A, B, and C compared to the untreated control group. The mean TEC (x106/cu.mm) for groups A, B, and C was 7.604 ± 0.39, 6.32 ± 0.28, and 6.89 ± 0.85, respectively, before treatment, and on days 14th and 28th, they were 8.42 ± 0.57 and 8.23 ± 0.67, 7.24 ± 0.14 and 6.98 ± 0.71, and 7.70 ± 0.64 and 8.10±0.42, respectively, after treatment. Before therapy, the mean TEC (x106/cu.mm) of an untreated control group (Group D) was 6.92 ± 0.64, and on the 14th and 28th days after treatment, it was 6.06 ± 0.71 and 5.98±0.18, respectively.

On the other hand, all treatment groups showed a non-significant decrease tend in the mean TLC (x103/cu.mm), as contrast to the untreated control group. In group A, B, and C, the mean TLC ($x10^3$/cu.mm) values were 12.67 ± 0.18, 11.55 ± 0.14, and 13.67 ± 0.71, respectively, before treatment. The mean TLC ($x10^3$/cu.mm) on 14th and 28th days in group A, B, and C were 8.98 ± 0.07 and 6.88 ± 0.71, 9.15 ± 0.18 and 8.88 ± 0.57, 7.88 ± 0.64 and 5.97 ± 0.94, respectively. While the mean TLC (x103/cu.mm) of the untreated control group (Group D) was 9.61 ± 0.17 before treatment, it was 11.94 ± 0.27 and 12.79 ± 0.15 on the 14th and 28th days, respectively.

Table 3

Effects of Triclabendazole, Oxyclozanide and Nitroxynil on hematological parameters

Hematological Values	Time Intervals	Treatment Groups			Control Group
		A	B	C	D
Hb (gm %)	0 Days	6.49 ± 0.40	6.69 ± 0.57	6.32 ± 0.78	6.78 ± 0.15
	14th Days	8.76 ± 0.34**	9.24 ± 0.32**	9.80 ± 0.28**	7.09 ± 0.17
	28th Days	9.48 ± 0.38**	9.56 ± 0.46**	10.38 ± 0.51**	6.59 ± 0.23
PCV (%)	0 Days	27.48 ± 0.48	23.90 ± 0.91	26.32 ± 0.58	26.84 ± 0.40
	14th Days	28.28 ± 0.36**	24.78 ± 0.80**	27.86 ± 0.46**	24.78 ± 0.79
	28th Days	28.60 ± 1.17**	26.62 ± 1.02**	29.16 ± 0.71**	25.10 ± 0.39
TEC ($x10^6$/cu.mm.)	0 Days	7.604 ± 0.39	6.32 ± 0.28	6.89 ± 0.85	6.92 ± 0.64
	14th Days	8.42 ± 0.57*	7.24 ± 0.14*	7.70 ± 0.64*	6.06 ± 0.71
	28th Days	8.23 ± 0.67**	6.98 ± 0.71**	8.10 ± 0.42**	5.98 ± 0.18
TLC ($x10^3$/cu.mm)	0 Days	12.67 ± 0.18	11.55 ± 0.14	13.67 ± 0.71	9.61 ± 0.17
	14th Days	8.98 ± 0.07	9.15 ± 0.18	7.88 ± 0.64	11.94 ± 0.27
	28th Days	6.88 ± 0.71	8.88 ± 0.57	5.97 ± 0.94	12.79 ± 0.15

The above values represent the mean ± standard deviation (SD) of each four groups

** = Significant at ($P < 0.01$) * = Significant at ($P < 0.05$)

Note: Hb=Hemoglobin, PCV= Packed Cell Volume, TEC= Total Erythrocyte Count, TLC= Total Leukocyte Count

3.2. Discussion

This study evaluated the efficacy of the drugs triclabendazole, oxyclozanide, and nitroxynil available in government hospitals against caprine fascioliasis at neighboring household farms near the Upazilla Livestock Office and Veterinary Hospital in Naldanga, Natore. Therefore, a total of 60 infected goats out of 417 goats were used for the field anthelmintic study throughout the course of 28 days, depending on the history, clinical signs and symptoms, and fecal examination. As a trustworthy indicator of the actual figure of parasites in the host, the effectiveness was assessed based on the % reduction of mean egg per gram (EPG) count of feces. In addition to the EPG count, changes in the RBC, Hb, PCV, and TLC values also showed efficacy in comparison to pre-treatment results. The results of the current experiment showed that, EPG counts in groups A, B, and C were considerably ($P < 0.01$) decreased on days 3rd, 7th, 14th, and 28th, while EPG counts in group D (the untreated control group) were significantly ($P < 0.01$) raised from day 3rd through the experiment.

In this current study, triclabendazole treatment showed reduction of EPG count at 28th days by 78.40% against Fasciola infected goats. The same outcome was reported by Elitok et al. (2006), Khanam et al. (2015), Khan et al. (2017), and Wahaab et al. (2019). In contrast to our findings, Keyyu et al. (2006), Hassan et al. (2012), and Sanabria et al. (2013) demonstrated better efficiency (98.5–100 %) against naturally *F. hepatica* infected in cattle and sheep. In oxyclozanide treated group, 73.33 % efficacy was recorded on 28th days which is compatible with the results of Babiker et al. (2012), Khanam et al. (2015), and Khan et al. (2017) but not compatible with those of Athar et al. (2011) and Shokier et al. (2013). According to Paraud et al. (2009), oxyclozanide reduced worm burdens by up to 95.9 %. Later, Mooney et al. (2009) also reported more than 98% effectiveness in sheep against *F. hepatica*. In this study, nitroxynil's effectiveness against Fasciola infection was 83.11 % in the treated group. The results of nitroxynil were consistent with those of Durrani et al. (2007) and Khanam et al. (2015), who found that nitroxynil was 93.88 % and 83.04 % effective against fascioliasis, respectively, with no adverse effects following medication. Others have reported similar findings in cattle, including Asaduzzaman (2008) and Wahaab et al. (2019). The EPG count of an untreated control group, however, considerably increased on 3rd, l4th, 21th and 28th days by roughly 2.74 %, 8.35 %, and 22.66 %, respectively.

In comparison to the control group on day 0th, the mean Hb, PCV, and TEC were significantly ($P < 0.01$ and $P < 0.05$) higher on day 7th in all three treatment groups. On the 28th day following anthelmintic treatment, groups A, B, and C all experienced significantly ($P < 0.01$ and $P < 0.05$) greater mean Hb, PCV, and TEC values than Control Group. The elevated Hb, PCV, and TEC values in the anthelmintic treated groups were in accordance with earlier studies by Khalil et al. (2008), Tibbo (2000), and Shrimali et al. (2016). On the other hand, the mean TLC values in the treated groups decreased but not significantly compared to the control group, which was in agreement with the results of Khanam et al. (2015) and Shrimali et al. (2016).

4. Conclusions

Several reviews of inland literature in Bangladesh have revealed fascioliasis as the most prevalent parasitic disease of goat. Therefore, number of flukicidal drugs are available in the market and are being used by veterinarians. Under the circumstances, the current study reveals that nitroxynil (nitronex®) is highly effective for reduction of EPG and hematological parameters (Hb, PCV, TEC, and TLC) for fascioliasis in goat than that of Triclabendazole (Fasinex®) and Oxyclozanide (Tremacid®) during the experiment. However, the present findings are also preliminary control efficacy studies of anthelmentics against parasitic infestation, which may aid the future researchers to investigate the detailed pharmacokinetic and toxic effects for wide range of therapeutic uses of anthelmintics in other animals. Furthermore, additional research is necessary to fully understand the precise chemotherapeutic and harmful effects of the anthelmintics that are commonly employed in Bangladesh's various agro-ecologies, animal species, and livestock management systems. Unknown environmental factors might have affected the statistical analysis and the study's results because we conducted a field trial only. Consequently, it is essential to carefully consider the study's findings.

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Conflict of interest

The author declared that there is no conflict of interest.

Financial disclosure

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