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Comparative efficacy of fenbendazole and Aloe Vera juice in gastrointestinal nematode infestation in goats

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Abstract

The present study was done with the objective of assess and compare the efficacy of fenbendazole and Aloe Vera juice in gastrointestinal nematode infestation in goats. The goats having EPG ≥ 500 were randomly divided into three groups: Group I (Fenbendazole @ 7.5 mg/kg BW orally once), Group II (Aloe Vera juice @ (1 ml/2 g)/5 kg BW orally once) and Group III (untreated control, n=10). Clinically, affected goats exhibited rough hair coat, poor body condition, weakness, pale mucous membranes and diarrhoea with pasty faeces, along with increased body temperature, respiratory rate and heart rate. Hemato-biochemical analysis revealed significant reductions in haemoglobin, packed cell volume, total erythrocyte count, lymphocytes, total protein and albumin, while AST and ALT levels were increased. Faecal examinations were conducted on day 0, 14 and 21 post-treatments. Therapeutic evaluation on day 21 showed marked improvement in clinical, haematological and biochemical parameters along with reduction in EPG levels in treated groups. Fenbendazole exhibited 98.53% efficacy, whereas *Aloe Vera* showed 74.46% efficacy. Although chemical anthelmintic was more effective, its repeated and improper use may lead to resistance, whereas herbal anthelmintics are safer, cost-effective and eco-friendly, offering a sustainable alternative.

Keywords: Fenbendazole, Aloe Vera, EPG, anthelmintic, resistance, therapeutic efficacy

Introduction

Goats are sociable and intelligent animals that have been domesticated for more than 10,000 years and are valued for their meat, milk, skin, and fiber (Genaro *et al.*, 2010). However, gastrointestinal nematodiasis is one of the most important parasitic diseases affecting goats, leading to significant economic losses due to mortality, reduced growth rate, weight loss, and decreased meat and milk production (Islam, 1985 and Rajakaruna *et al.*, 2011). Infected animals commonly show clinical signs such as anorexia, diarrhoea, weakness, anaemia, rough hair coat, and edema depending on the parasite species (Babjak *et al.*, 2017).

Control of gastrointestinal nematodes in small ruminants has largely depended on the use of chemical anthelmintics. However, indiscriminate and frequent use of these drugs has led to the development of widespread anthelmintic resistance, making parasite control increasingly difficult worldwide (Kaplan, 2004 and Eke *et al.*, 2019). This situation has created a need to explore alternative, safe, and environment friendly methods for controlling parasitic infections. Medicinal plants have gained increasing attention as potential alternatives to synthetic anthelmintics due to their safety, affordability, and eco-friendly nature. Several plants used in ethnoveterinary medicine have shown promising anthelmintic properties (Waller, 1999 and Laudato *et al.*, 2013). Among these, Aloe Vera has been reported to possess larvicidal and egg-hatching inhibition effects against gastrointestinal nematodes such as *Haemonchus contortus* in sheep and goats (Egualle *et al.*, 2007, Maphosa *et al.*, 2010 and Ahmed *et al.*, 2013).

Therefore, the present study was undertaken to evaluate and compare the therapeutic efficacy of fenbendazole and Aloe Vera juice against gastrointestinal nematodes in goats as a potential alternative approach for parasite control [14, 17, 29, 8, 20, 13, 39, 24, 12, 26, 2].

Materials and methods

Faecal samples were collected directly from the rectum of 200 goats reared in farms around Shirwal and those presented to the Veterinary Clinical Complex, Krantisinh Nana Patil College of Veterinary Science, Shirwal. Samples were examined by direct smear, flotation and sedimentation techniques. Gastrointestinal nematodiasis was diagnosed based on morphological characteristics of eggs described by Soulsby (1986) and Samad (1996). Out of 200 goats screened, 156 were found positive, and 70 goats with EPG ≥ 500 , aged above six months to four years, were selected for the study.

Goats in all groups were examined on day 0 (pre-treatment) and re-evaluated on days 14 and 21 post-treatment. Clinical parameters including general appearance, body weight, rectal temperature ($^{\circ}\text{F}$), colour of visible mucous membranes, general body condition, lymph node status, dehydration, respiratory rate (breaths/min), and heart rate (beats/min) were recorded. Haematological parameters such as Haemoglobin (Hb), Packed Cell Volume (PCV), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC), Total Erythrocyte Count (TEC), Total Leukocyte Count (TLC) and Differential

Leukocyte Count (DLC) were analysed using an automated blood analyser (Abacus ABJ Vet-5). Serum biochemical parameters including Alanine Aminotransferase (ALT), Aspartate Aminotransferase (AST), Total Protein, Albumin and Globulin were estimated using standard assay kits with a semi-automatic biochemistry analyser (Alta ADX-CHEM-220).

Faecal samples were examined by direct microscopy, sedimentation and flotation techniques, and the intensity of infection was determined by calculating eggs per gram (EPG) using the Modified McMaster egg counting technique.

Preparation and storage of aqueous Aloe Vera juice

A crude extract was prepared as described by Kaingu *et al.* (2012) where fresh *Aloe barbadensis* leaves were chopped using machete (knife) and placed in a rotary blender and blended to slurry. The slurry was then squeezed to get the viscous juice which was placed in the glass bottles and stored in a refrigerator (Plate 1, 2 and 3)

In 50gm of Aloe Vera pulp 25ml of Aloe Vera juice was obtained [19].



Plate 1: *Aloe Vera* (*Aloe barbadensis*), Plate 2: Preparation of *Aloe Vera* juice



Plate 3: Weighing of *Aloe Vera* juice

Treatment protocol

Goats with faecal samples positive for gastrointestinal nematodal eggs and having EPG >500 were selected for the present study and were randomly divided into three groups viz., I, II and III (Positive control) consisting of 30 animals in each

two-treatment Group I, and Group II and 10 animals were kept as positive control in Group III (Table1). Two different drugs were administered as a single dose and the therapeutic efficacy was evaluated on day 14th and 21st post treatment.

Table 1: Details of therapeutic regimen

Sr. No.	Groups	Treatment offered	No. of animals	Frequency of sample Collection
1.	Group 1	Liq. Fenbendazole (7.5mg/kg PO once)	30	0 th day, 14 th day and 21 th day
2.	Group 2	<i>Aloe Vera</i> juice 1ml (2gm)/5kg PO once)	30	0 th day, 14 th day and 21 th day
3.	Group 3	Untreated/positive Control Group	10	0 th day, 14 th day and 21 th day

Multiple electrolytes, hematinic injection, liver protectants and multivitamins were used as supportive therapy.

Results and discussion

Clinical Findings and Body Parameters.

Goats naturally infected with gastrointestinal nematodes, predominantly exhibited physical weakness and low body condition scores between 2.0 and 3.0. A thorough physical examination revealed slight pale to pale conjunctival mucous membranes, rough hair coats, and the of diarrhoea with pasty faeces leading to significant soiling of the tail and hindquarters

Table 2: Clinical and body parameters in goats with gastrointestinal nematodiasis (n = 156)

Parameters	Gradation	No of goats positive	Per cent positive
Conjunctival mucous membranes	Normal	29	18.59
	Slight pale	60	38.46
	Pale	67	42.95
Hair coat	Rough	122	78.21
	Normal	34	21.79
Feces	Semisolid	96	61.54
	Pasty	38	24.36
	Normal	22	14.10
Soiling of the tail and hindquarters	Present	130	83.33
	Absent	26	16.67
BCS	0	0	0.00
	1	42	26.92
	2	69	44.23
	3	45	28.85
	4	0	00.00
Dehydration Status	+	47	30.13
	++	86	55.13
	+++	23	14.74
Lymph node examination	Swollen	38	24.36
	Normal	118	75.64

A total of 156 goats positive for gastrointestinal nematode infestation were examined for clinical signs and body parameters. Pale mucous membranes were observed in 42.95% goats, slightly pale in 38.46% and normal in 18.59%, indicating anaemia associated with parasitic infection. Rough hair coat was recorded in 78.21% goats, while 21.79% had normal hair coat. Altered faecal consistency was observed with semisolid faeces in 61.54%, pasty faeces in 24.36% and normal faeces in 14.10% goats. Soiling of tail and hindquarters was present in 83.33% goats. Most animals showed poor to moderate body condition with BCS 2 in 44.23%, BCS 3 in 28.85% and BCS 1 in 26.92%. Moderate dehydration was recorded in 55.13%

goats, mild in 30.13% and severe in 14.74%. Swollen lymph nodes were observed in 24.36% goats (Table 2).

Out of the 156 infected goats, 70 animals having EPG $\geq$ 500 and showing similar clinical and hemato-biochemical parameters were selected for therapeutic study. These were divided into three groups: Group I (n=30) treated with fenbendazole suspension, Group II (n=30) treated with crude *Aloe Vera* juice and Group III (n=10) kept as untreated positive control. Clinical, haematological, and biochemical parameters were recorded on day 0 (before treatment), and subsequently on day 14 and day 21 post-treatment.

**Plate 4:** CMM before and after Aloe Vera treatment



Plate 5: CMM before and after fenbendazole treatment



Plate 6: Swollen prescapular lymph node and emaciated goat with gastrointestinal nematode

Clinical parameters

Table 3: Clinical parameters and body weight before and after treatment (Mean± SE)

Parameter	Group	Day 0 (Mean± SE)	Day 14 (Mean± SE)	Day 21 (Mean ±SE)	
Rectal Temperature (°F)	I	102.72±0.06	102.32±0.05	102.00±0.06	S
	II	102.88±0.07	102.48±0.07	102.10±0.07	S
	III	102.76±0.08	103.03±0.09	103.14±0.08	S
		NS	S	S	
Respiration Rate (Breaths/min)	I	28.13±0.65	26.00±0.38	23.27±0.34	S
	II	30.00±0.82	27.53±0.52	24.87±0.38	S
	III	28.20±1.25	30.80±1.05	31.80±1.03	S
		NS	S	S	
Heart Rate (Beats/min)	I	84.27±0.49	81.00±0.32	78.47±0.30	S
	II	87.13±0.72	83.47±0.45	81.13±0.45	S
	III	85.60±1.20	88.20±1.11	89.80±1.06	S
		S	S	S	
Body Weight (kg)	I	28.44±1.83	29.55±1.82	30.13±1.79	NS
	II	28.02±1.71	29.06±1.69	29.60±1.67	NS
	III	26.89±3.25	26.46±3.23	26.31±3.22	NS
		NS	NS	NS	

Clinical examination of goats naturally infected with gastrointestinal nematodes revealed a slightly elevated rectal temperature before treatment. In both treated groups (Fenbendazole and *Aloe Vera*), rectal temperature showed a significant reduction on day 14 and day 21 after treatment, whereas the untreated control group showed a gradual increase. The detailed values are presented in Table 4.2. Similar observations were reported by Rajpura *et al.* (2019) and Puri and Waghmare (2008) [30, 28].

Respiratory rate (breaths/min) also showed a significant reduction in the treated groups on day 14 and day 21 following treatment, while the untreated control group exhibited a progressive increase. The values are shown in Table 4.2. These findings are in agreement with Rajpura *et al.* (2019) and Puri and Waghmare (2008), who reported increased respiratory rate in parasitized goats due to anemia and reduced oxygen carrying capacity [30, 28].

Heart rate (beats/min) decreased significantly in both treated groups after treatment, whereas the untreated control group showed a gradual increase during the observation period. Similar observations were also reported by Rajpura *et al.* (2019) and Puri and Waghmare (2008) [28, 30].

Body weight showed improvement in both treated groups during the post-treatment period, while the untreated control group showed a gradual decrease. Similar improvements in

body weight following anthelmintic treatment were reported by Al-Quaisy *et al.* (1987), Kumar *et al.* (2008), Sharma *et al.* (2014) and Sharma *et al.* (2016), who stated that removal of gastrointestinal parasites improves nutrient utilization and growth performance in small ruminants [4, 23, 35, 34].

Hematological parameters

Table 4: Hematological parameters in different groups before and after treatment (Mean± SE)

Parameter	Group	Day 0 (Mean ±SE)	Day 14 (Mean ±SE)	Day 21 (Mean ±SE)	
Hemoglobin (g/dl)	I	7.24±0.06	8.14±0.06	8.51±0.05	S
	II	7.30±0.06	8.00±0.06	8.51±0.05	S
	III	7.58±0.11	7.37±0.11	7.24±0.11	NS
	S	S	S	S	
TEC (×10 ⁶ /μl)	I	7.86±0.06	8.95±0.06	9.64±0.06	S
	II	7.94±0.06	8.77±0.06	9.69±0.06	S
	III	8.24±0.16	8.02±0.16	7.84±0.16	NS
	S	S	S	S	
PCV (%)	I	22.25±0.14	24.78±0.12	25.96±0.15	S
	II	22.42±0.16	24.50±0.13	25.91±0.13	S
	III	23.15±0.35	22.56±0.31	22.46±0.32	NS
	S	S	S	S	
TLC (×10 ³ /μl)	I	11.73±0.19	10.80±0.13	9.54±0.10	S
	II	12.30±0.18	11.36±0.13	10.25±0.11	S
	III	11.75±0.33	12.14±0.33	12.71±0.33	NS
	NS	S	S	S	
Neutrophils (%)	I	49.47±0.62	41.93±0.50	33.93±0.50	S
	II	51.33±0.53	45.77±0.45	39.33±0.32	S
	III	51.60±0.67	52.50±0.76	54.70±1.16	NS
	NS	S	S	S	
Eosinophils (%)	I	5.27±0.17	2.70±0.09	1.70±0.09	S
	II	5.90±0.21	2.80±0.07	1.80±0.07	S
	III	5.20±0.25	6.30±0.26	6.90±0.23	S
	S	S	S	S	
Basophils (%)	I	0.83±0.14	0.60±0.09	0.60±0.09	NS
	II	0.97±0.14	0.80±0.07	0.80±0.07	NS
	III	0.80±0.25	1.30±0.21	1.60±0.16	S
	NS	S	S	S	
Lymphocytes (%)	I	41.20±0.69	52.40±0.55	62.40±0.55	S
	II	38.90±0.65	48.20±0.44	56.60±0.33	S
	III	39.40±0.65	36.50±0.98	32.60±1.32	NS
	NS	S	S	S	
Monocytes (%)	I	3.07±0.23	2.37±0.13	1.37±0.13	S
	II	3.17±0.30	2.43±0.10	1.47±0.09	S
	III	3.00±0.37	3.40±0.30	4.20±0.36	NS
	NS	S	S	S	
MCV (fL)	I	27.81±0.08	27.63±0.11	27.19±0.10	S
	II	27.68±0.16	27.96±0.14	27.38±0.10	S
	III	28.09±0.15	28.52±0.50	28.69±0.53	NS
	NS	S	S	S	
MCH (pg)	I	8.98±0.03	8.97±0.03	8.84±0.03	S
	II	8.96±0.05	8.99±0.05	8.89±0.03	NS
	III	9.11±0.05	9.23±0.16	9.27±0.16	NS
	NS	S	S	S	
MCHC (g/dl)	I	32.31±0.03	32.47±0.03	32.52±0.03	NS
	II	32.36±0.03	32.18±0.16	32.48±0.03	NS
	III	32.45±0.06	32.34±0.06	32.31±0.06	NS
	NS	NS	S	S	

Hematological examination of goats naturally infected with gastrointestinal nematodes revealed anemia characterized by low hemoglobin levels before treatment. Following treatment, Hb values increased significantly in both treated groups (Fenbendazole and Aloe Vera) on day 14 and day 21, while the untreated control group showed a gradual decrease (Table 4). Similar findings were reported by Ahmed *et al.* (2015), Puri

and Waghmare (2008) and Katoch *et al.* (1998), who also observed decreased Hb levels in parasitized goats due to the blood-sucking activity of gastrointestinal nematodes [3, 21].

The mean TEC increased significantly in both treated groups during the post-treatment period, whereas the untreated control group showed a gradual decrease. Comparable observations were reported by Ahmed *et al.* (2015) and Katoch *et al.* (1998),

who recorded reduced TEC in parasitized goats, while Puri and Waghmare (2008) reported a significant increase in erythrocyte count following effective anthelmintic treatment [3, 21, 28, 30].

PCV values also increased significantly in the treated groups after treatment, while the untreated control group showed a decreasing trend. Similar findings were reported by Regassa *et al.* (2013), Ahmed *et al.* (2015) and Shashank *et al.* (2019), who observed significantly reduced PCV values in goats infected with gastrointestinal nematodes [32, 36, 3].

TLC values were elevated before treatment and decreased significantly in both treated groups following therapy, whereas the untreated control group showed a gradual increase. Similar leukocytosis in infected goats was reported by Abdel *et al.* (2000) and Shashank *et al.* (2019), suggesting an immune response to parasitic infection [36, 1].

Neutrophil and eosinophil counts were significantly higher before treatment and decreased markedly in the treated groups after therapy, whereas the untreated group showed an

increasing trend. Similar findings of eosinophilia and neutrophilia associated with parasitic infections were reported by Rajpura *et al.* (2019), Arora *et al.* (2003) and Maiti *et al.* (1999). In contrast, lymphocyte count increased significantly after treatment, while the untreated group showed a decrease. Similar observations were reported by Rajpura *et al.* (2019) and Jayraw and Raote (2004) [7, 30, 25].

Erythrocytic indices also showed improvement following treatment. MCV and MCH values decreased significantly towards normal range in the treated groups, while MCHC showed a slight increase, whereas the untreated group showed unfavorable changes. Similar observations were reported by Ameen *et al.* (2006, 2010), who stated that erythrocytic indices tend to return toward normal values following effective anthelmintic therapy [5, 6].

Biochemical parameters

Table 5: Biochemical parameters in different groups before and after treatment (Mean± SE)

Total Protein (g/dl)	I	5.13±0.04	5.56±0.04	6.02±0.04	S
	II	5.00±0.05	5.76±0.03	6.05±0.04	S
	III	5.10±0.06	5.04±0.05	4.94±0.06	NS
		NS	S	S	
Albumin (g/dl)	I	2.00±0.03	2.85±0.03	3.15±0.02	S
	II	1.93±0.03	2.81±0.03	3.09±0.02	S
	III	1.98±0.05	1.85±0.05	1.75±0.04	S
		NS	S	S	
Globulin (g/dl)	I	3.26±0.03	2.90±0.03	2.71±0.02	S
	II	3.15±0.04	2.95±0.03	2.73±0.03	S
	III	3.21±0.05	3.41±0.06	3.85±0.06	S
		NS	S	S	
ALT (IU/L)	I	40.00±0.99	31.13±0.77	25.17±0.65	S
	II	39.03±1.14	29.23±0.88	26.03±0.76	S
	III	41.00±2.08	48.00±1.87	51.20±1.63	S
		NS	S	S	
AST (IU/L)	I	80.77±1.27	60.40±1.03	50.37±0.80	S
	II	81.13±1.13	60.73±0.93	51.93±0.75	S
	III	80.50±2.02	94.50±1.57	95.80±0.85	S
		NS	S	S	

Biochemical examination of goats naturally infected with gastrointestinal nematodes revealed decreased total protein levels before treatment. After treatment, total protein increased significantly in both treated groups (Fenbendazole and *Aloe Vera*), whereas the untreated control group showed a gradual decrease (Table 5). Similar findings were reported by Shashank *et al.* (2019) and Arora *et al.* (2003), who observed reduced total protein levels in parasitized goats due to protein-losing gastroenteropathy and intestinal damage [36, 7].

Serum albumin levels were reduced before treatment and increased significantly in both treated groups during the post-treatment period, while the untreated control group showed a decreasing trend. Similar observations were reported by Shashank *et al.* (2019), Siddiqua *et al.* (1989) and Prasanthi *et al.* (1990) [36, 37, 27].

Globulin levels were higher before treatment and decreased significantly following treatment in both treated groups, whereas the untreated control group showed a gradual increase.

Similar hyperglobulinemia in parasitized goats was reported by Shashank *et al.* (2019) and Bhat *et al.* (2004), indicating an immune response against parasitic antigens.

ALT levels were elevated before treatment and decreased significantly in the treated groups after therapy, whereas the untreated control group showed a progressive increase. Similar findings were reported by Sharma *et al.* (2001), Rashid *et al.* (2015) and Shashank *et al.* (2019).

AST levels were also elevated prior to treatment and decreased significantly in both treated groups during the post-treatment period, while the untreated control group showed an increasing trend. Comparable observations were reported by Sharma *et al.* (2001), Rashid *et al.* (2015) and Hassan *et al.* (2012), indicating normalization of enzyme levels following effective anthelmintic therapy [36, 10, 16, 31].

Egg Per Gram (EPG)

Table 6: The Mean egg per gram (EPG) in different groups before and after treatment

Parameters	Group	Day 0 (Mean± SE)	Day 14 (Mean ±SE)	Day 21 (Mean ±SE)	
EPG	I	1695±22	333±7	25±4	S
	II	1723±22	880±6	440±6	S
	III	1665±38	1765±36	1930±52	S
		NS	S	S	

Faecal examination of goats naturally infected with gastrointestinal nematodes showed high EPG counts before treatment. In the present study, mean EPG levels significantly decreased in the treated groups, from 1695 ± 22 to 25 ± 4 in Group I (Fenbendazole) and from 1723 ± 22 to 440 ± 6 in Group II (Aloe Vera) by day 21. In contrast, the untreated control

group showed an increase from 1665 ± 38 to 1930 ± 52 . (Table 6). Similar findings were reported by Katoch *et al.* (2000), Barua *et al.* (2015) and Godara *et al.* (2011), indicating effective reduction of parasitic load after treatment [9, 15, 21].

Therapeutic efficacy

Table 7: Comparative efficacy of fenbendazole and Aloe Vera against gastrointestinal nematodiasis in goats before (BT) and after therapy (AT)

Groups	Days	EPG	% Efficacy
Group I Fenbendazole	0	1695 ± 22	0%
	14	333 ± 7	80.35%
	21	25 ± 4	98.53%
Group II Aloe Vera	0	1723 ± 22	0%
	14	880 ± 6	48.93%
	21	440 ± 6	74.46%

Goats with an initial faecal egg count (EPG) of more than 500 were divided into three groups. Group I (n=30) was treated with fenbendazole at 7.5 mg/kg body weight orally, Group II (n=30) received crude aqueous *Aloe Vera* juice (1 ml or 2 g/5 kg body weight), and Group III (n=10) served as untreated control. In Group I, the mean pre-treatment EPG was 1695 ± 22 on day 0. Following treatment with fenbendazole, the EPG significantly decreased to 333 ± 7 on day 14 showing 80.35% efficacy which further declined to 25 ± 4 on day 21, showing a maximum efficacy of 98.53%. Significant improvement in clinical signs and hemato-biochemical parameters were also observed. In Group II, the baseline mean EPG was 1723 ± 22 on day 0. After treatment with *Aloe Vera*, the EPG decreased to 880 ± 6 on day 14 showing 48.93% efficacy and further to 440 ± 6 on day 21, indicating a final efficacy of 74.46%. Similar improvements in clinical and hemato-biochemical parameters were recorded, though the reduction in parasite load was slower than fenbendazole.

Previous studies have also reported the anthelmintic potential of *Aloe Vera*, attributed to bioactive compounds such as aloin (Sikarwar *et al.*, 2010; Dubey *et al.*, 2012). However, the present findings indicate that fenbendazole is significantly more effective than *Aloe Vera* in reducing gastrointestinal nematode egg counts in goats [38, 11].

Conclusions

Goats affected with gastrointestinal nematodiasis showed poor body condition, anemia, and altered hematological and biochemical parameters. Increased fecal egg per gram (EPG) counts confirmed heavy parasitic infection. Treatment with both fenbendazole and *Aloe Vera* juice resulted in improvement in clinical, hemato-biochemical parameters and reduction in worm load. However, fenbendazole showed higher efficacy (98.53%) compared to *Aloe Vera* juice (74.46%). Although chemical anthelmintics are more effective, herbal alternatives like *Aloe Vera* may serve as safer, cost-effective, and eco-friendly options, warranting further research for sustainable parasite control.

- **Conflict of Interest:** Not available
- **Financial Support:** Not available

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