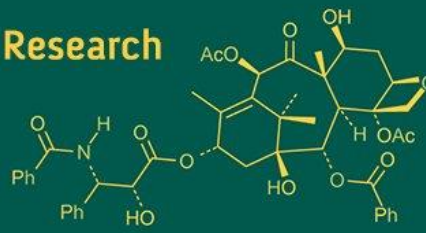


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Anthelmintic activity of aqueous leaf extract of *Murraya koenigii* Linn. against gastrointestinal parasites in goats

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Abstract

The present study evaluated the anthelmintic activity of aqueous leaf extract of *Murraya koenigii* Linn. (AEMK) against naturally acquired gastrointestinal parasites in goats. Forty naturally infected goats (EPG > 500) were divided into four groups of 10 animals each. Group I served as infected control, Group II received fenbendazole (5 mg/kg, single oral dose), Group III received AEMK (1 g/kg, single oral dose) and Group IV received AEMK (2 g/kg, single oral dose). The study was conducted for 21 days. Phytochemical screening (qualitative and quantitative HPLC) confirmed the presence of alkaloids (17.07 mg/g), tannins (13.13 mg/g) and flavonoids (0.67 mg/g). AEMK produced dose-dependent faecal egg count reduction (48.00% at 1 g/kg and 67.57% at 2 g/kg) with significant improvement in body weight, haematological parameters (Hb, TEC, PCV) and serum biochemical parameters (total protein) while liver enzymes remained within normal limits. No adverse effects were observed. The results indicate that aqueous leaf extract of *M. koenigii* possesses moderate anthelmintic activity and can serve as a safe, cost-effective herbal alternative for integrated parasite management in goats.

Keywords: *Murraya koenigii*, anthelmintic, goats, gastrointestinal parasites, aqueous extract, faecal egg count

Introduction

Animal husbandry constitutes a vital component of India's agricultural economy, particularly for rural livelihoods, marginal farmers, and landless labourers where average landholdings are below four hectares. Small ruminants such as goats and sheep play a significant role due to their resilience in adverse climatic conditions and minimal resource requirements. The livestock sector contributes approximately 4.11% to the national GDP and 25.6% to the agricultural GDP while supplying essential protein-rich food sources (Rajashekhar *et al.*, 2023) [27].

Gastrointestinal parasitic infections, especially helminthiasis, remain one of the major constraints to sustainable small ruminant production. These parasites cause substantial economic losses through reduced body weight gain, anemia, depletion of plasma proteins, decreased milk yield, and impaired reproductive performance (Mahusoon *et al.*, 2004; Shameem *et al.*, 2021; Choubisa and Jaroli, 2013; Sharma *et al.*, 2014; Luscher *et al.*, 2005) [21, 33, 5 34]. High prevalence of helminth infections has been documented in goats and other ruminants across India (Bisset, 1994; Holmes, 1987) [3, 14].

Although synthetic anthelmintic drugs are highly effective, their prolonged use is associated with drug resistance, adverse effects, and environmental contamination (Waller *et al.*, 1995) [40]. Consequently, medicinal plants have gained attention as safe, cost-effective, and eco-friendly alternatives for parasite control (Jaiswal *et al.*, 2010; Batista *et al.*, 1999; Slomp *et al.*, 2009) [2, 17, 35].

Murraya koenigii (L.) Spreng. (Family Rutaceae), commonly known as curry leaf, is a widely distributed medicinal plant in India and Southeast Asia. *In vitro* studies have demonstrated significant anthelmintic activity of its leaf extracts against helminths, attributed to bioactive phytoconstituents such as alkaloids (mahanimbine, girinimbine), flavonoids, tannins, and saponins (Molla and Bandhopadhyay, 2016; Sujith *et al.*, 2018; Swami *et al.*, 2025) [22, 37, 38].

Aqueous extracts are of particular interest because they closely resemble traditional formulations, are farmer-friendly, and require no organic solvents (Githiori *et al.*, 2003) ^[12].

Despite promising traditional use and *in vitro* results, scientific validation of the anthelmintic efficacy of aqueous leaf extract of *M. koenigii* against naturally acquired gastrointestinal parasites in goats under *in vivo* conditions remains limited.

In the current scenario of widespread anthelmintic resistance, such medicinal plants offer a sustainable “green dewormer” approach for integrated parasite management in small ruminants (Partridge *et al.*, 2020; Hounzangbe-Adote *et al.*, 2005) ^[15, 26].

In view of the above, the present study was undertaken to evaluate the anthelmintic activity of aqueous leaf extract of *Murraya koenigii* Linn. against gastrointestinal parasites in goats.

Materials and Methods

Collection and authentication of plant material

Fresh leaves of *Murraya koenigii* Linn. were collected from the campus of Vasant Rao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani, and local markets. The plant material was authenticated by the Department of Botany, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani.

Preparation of herbal formulation

The leaves were air-dried under shade at room temperature and ground into coarse powder using an electric grinder. Aqueous extract was prepared by maceration method. One hundred grams of leaf powder was soaked in 1000 mL of distilled water in a conical flask and kept at room temperature for 48 h with intermittent shaking (three times daily). After 48 h, the mixture was filtered through muslin cloth followed by Whatman No. 1 filter paper. The filtrate was evaporated to dryness at room temperature under a fan. The dry extract obtained was weighed, stored in airtight

screw-capped vials in a refrigerator, and used as and when required.

Phytochemical screening

Qualitative phytochemical analysis

Qualitative tests were performed on the aqueous leaf extract of *Murraya koenigii* to detect the presence of major phytochemical constituents using standard methods described by Roberts (1981). Tests were carried out for alkaloids (Dragendorff's, Mayer's and Wagner's reagents), reducing sugars (Fehling's and Benedict's tests), glycosides (Benedict's and Fehling's tests after acid hydrolysis), tannins (ferric chloride and lead acetate tests), sterols (Salkowski's reaction), flavonoids (lead acetate test), saponins (foam test) and phenols (ferric chloride test).

Quantitative phytochemical analysis

Quantitative estimation of alkaloids, flavonoids and tannins in the aqueous leaf extract was performed by High Performance Liquid Chromatography (HPLC) at Mr. Biologist Lab, APT Research Centre, Pune using a Shimadzu HPLC system. Gallic acid, quercetin and caffeine were used as reference standards. Analysis was carried out on a C18 column (250 × 4.6 mm, 5 µm) with gradient elution (water + 0.1% formic acid and acetonitrile), flow rate of 1.0 mL/min, injection volume 20 µL, column temperature 30 °C and UV detection at 282 nm.

Experimental animals

The experimental protocol was approved by the Institutional Animal Ethics Committee (IAEC) vide resolution No. IEC-VCR (3)/01/2025 dated 19.09.2025. Forty naturally infected goats of either sex, aged more than 12 months and weighing 15–25 kg, were selected. Gastrointestinal helminth infection was confirmed by fecal examination, and only animals with egg per gram (EPG) count > 500 were included. The goats were randomly divided into four groups of ten animals each. Details of the treatment groups and schedule are presented in Table 1.

Table 1: Experimental design of groups and their treatments

Group	Name of Group	Drug Administration	No. of Animals
I	Infected Control	No treatment	10
II	Standard Drug Control	Fenbendazole @ 5 mg/kg body weight, oral, single dose	10
III	AEMK-I	Aqueous extract of <i>M. koenigii</i> @ 1 g/kg body weight, oral, single dose	10
IV	AEMK-II	Aqueous extract of <i>M. koenigii</i> @ 2 g/kg body weight, oral, single dose	10

All the animals were maintained under observation for the experimental period of 21 days.

Animal management

All experimental goats were housed in separate pens at Deshmukh Goat Farm, Pedgaon, Tal & Dist-Parbhani. They were allowed daily free grazing in the morning and supplemented with fresh grass and concentrate feed. Potable drinking water was provided *ad libitum*.

Sample collection

Blood and faecal samples were collected from each goat on day 0 (pre-treatment) and on days 7, 14 and 21 post-treatments.

Blood collection 5ml of blood was collected from the jugular vein of each goat. Two millilitres were taken in EDTA vials for haematological parameters and three

millilitres in clot activator vials for serum biochemical analysis. Blood was centrifuged at 3000 rpm for 20 min at 4 °C in a refrigerated centrifuge. The separated plasma and serum were harvested and stored at -20°C until analysis.

Faecal sample collection Fresh faecal samples were collected directly from the rectum into polythene bags on day 0, 7, 14 and 21 of the experiment. Samples were labelled, transported to the Department of Veterinary Parasitology and processed on the same day for estimation of eggs per gram (EPG) count of gastrointestinal helminth parasites.

Faecal, Biochemical and Haematological parameters

The anthelmintic efficacy was assessed by faecal egg per gram (EPG) count using Stoll's dilution method (Soulsby, 1982). Anthelmintic efficacy was calculated by the faecal egg count reduction (FECR) test (Coles *et al.*, 1992) ^[6].

Haemoglobin, total erythrocyte count (TEC), packed cell volume (PCV) and total leucocyte count (TLC) were estimated by standard methods (Benjamin, 2001). Serum samples were analysed for alanine aminotransferase (ALT), aspartate aminotransferase (AST) and total protein using commercial diagnostic kits on a semi-autoanalyzer.

Statistical analysis

The data obtained were analyzed using two-way ANOVA with SPSS software. Differences were considered statistically significant when $p \leq 0.05$.

Results and Discussion

The present experiment is conducted to assess the anthelmintic activity of aqueous leaf extract of *Murraya koenigii* in naturally infected gastrointestinal parasites in goats.

Extractability Percentage

Aqueous extraction of *Murraya koenigii* leaves yielded 10.2% of a dark brown, semi-solid extract. The colour and consistency were in partial agreement with earlier reports (Khare *et al.*, 2021; Saini *et al.*, 2013) ^[19].

Phytochemical analysis

Qualitative phytochemical screening of the aqueous leaf

extract of *Murraya koenigii* revealed the presence of alkaloids, tannins, flavonoids and saponins, while reducing sugars, glycosides, sterols and phenols were absent as shown in table 2. These findings are similar to those reported by Khare *et al.* (2021) ^[19].

Table 2: Qualitative phytochemical analysis of aqueous leaf extract of *Murraya koenigii*

Phytochemicals	Test Applied	Result
Alkaloids	Dragendorff's, Mayer's, Wagner's	Present
Reducing sugars	Fehling's, Benedict's	Absent
Glycosides	Benedict's, Fehling's (after hydrolysis)	Absent
Tannins	Ferric chloride, Lead acetate	Present
Sterols	Salkowski's reaction	Absent
Flavonoids	Lead acetate	Present
Saponins	Foam test	Present
Phenols	Ferric chloride	Absent

Quantitative HPLC analysis showed alkaloids (17.07 mg/g caffeine equivalents), tannins (13.13 mg/g gallic acid equivalents) and flavonoids (0.67 mg/g quercetin equivalents). The values were lower than those reported by Salomi and Manimekalai (2016) ^[32] but showed partial agreement with Firdaus *et al.* (2014) ^[9] and Sablania *et al.* (2019) ^[31].

Table 3: Quantitative phytochemical analysis (HPLC) of aqueous leaf extract of *Murraya koenigii*

Sr. No.	Phytochemical Group	Marker Compound	Expression	Content (mg/g dry extract)
1	Alkaloids	Caffeine	As caffeine equivalents	17.07
2	Tannins	Gallic acid	As gallic acid equivalents	13.13
3	Flavonoids	Quercetin	As quercetin equivalents	0.67

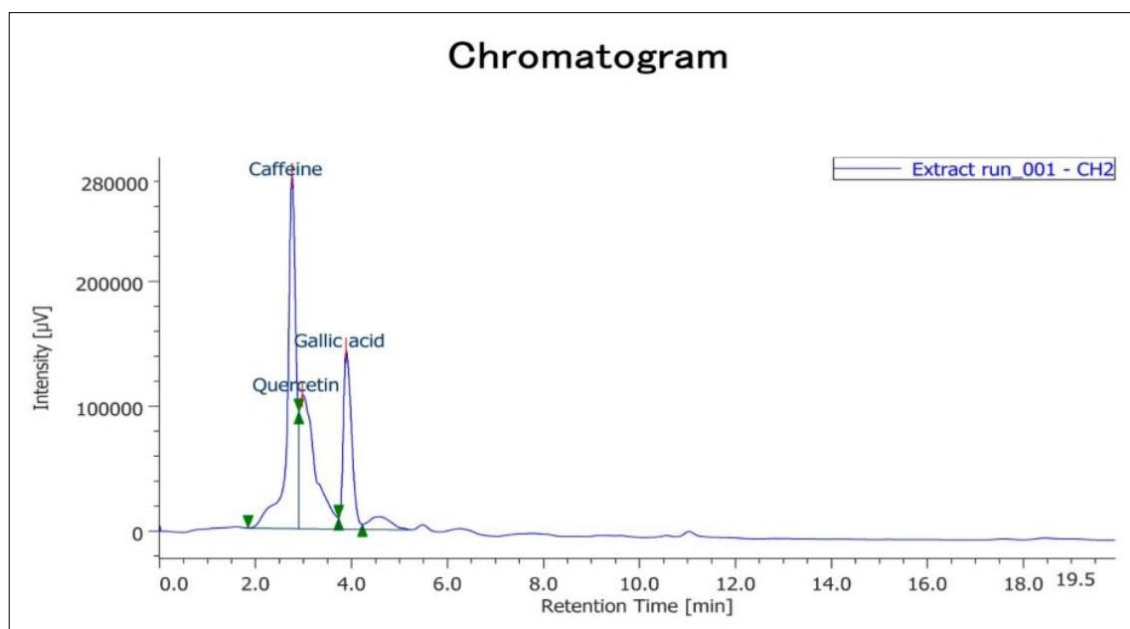


Fig 1: HPLC Chromatogram of the AEMK Extract

Anthelmintic Activity

The infected control group showed a progressive increase in EPG values over the study period, indicating continuous establishment and egg shedding of gastrointestinal parasites in untreated animals in table no. 4. The fenbendazole-treated group exhibited the highest reduction in EPG counts, with an FECR of 89.38%, indicating strong anthelmintic efficacy. In the AEMK-treated groups, a dose-dependent reduction in

EPG was observed. The group treated with 1 g/kg body weight showed a moderate reduction (FECR: 48.00%), while the group treated with 2 g/kg body weight showed a higher reduction (FECR: 67.57%). Overall, both AEMK-treated groups demonstrated significant reductions in EPG, with greater efficacy observed at the higher dose, although the effect remained lower than that of the standard drug. AEMK treatment showed a dose-dependent reduction in

EPG, with higher efficacy at 2 g/kg body weight compared to 1 g/kg. This effect may be attributed to the presence of bioactive compounds such as tannins, flavonoids, and alkaloids, known to affect parasite survival and development (Fernández *et al.*, 2010; Ferreira *et al.*, 2010; Symeonidou *et al.*, 2018) [7, 8, 39]. These findings were in agreement with

previous studies reporting dose-dependent anthelmintic activity of *Murraya koenigii* extracts (Molla and Bandyopadhyay, 2016) [22]. Although the efficacy of AEMK was lower than fenbendazole, the observed reduction in EPG suggests its potential as an alternative or supportive anthelmintic.

Table 4: Mean values+ SE of Eggs per gram in different experimental groups of goats. (n=10)

Groups	Treatment	Mean EPG level $\pm$ (SE) and FECR%				FECR%	Stat
		0 Day	7 th Day	14 th Day	21 st Day		
I	Infected Control	920.00 $\pm$ 46.66 ^c	1050.00 $\pm$ 54.26 ^{aBC}	1150.00 $\pm$ 54.26 ^{aAB}	1250.00 $\pm$ 54.26 ^{aA}		S
II	Fenbendazole	1130.00 $\pm$ 47.25 ^{aA}	560.00 $\pm$ 30.55 ^{cB}	310.00 $\pm$ 23.33 ^{dC}	120.00 $\pm$ 20.00 ^{dD}	89.38	S
III	AEMK @1 g/kg BW	1000.00 $\pm$ 36.51 ^{bcA}	820.00 $\pm$ 20.00 ^{bB}	670.00 $\pm$ 15.27 ^{bC}	520.00 $\pm$ 20.00 ^{bD}	48.00	S
IV	AEMK @ 2g/kg BW	1110.00 $\pm$ 31.44 ^{abA}	750.00 $\pm$ 26.87 ^{bB}	510.00 $\pm$ 27.68 ^{cC}	360.00 $\pm$ 22.11 ^{cD}	67.57	S
Stat		S	S	S	S		

Means with different superscripts A,B,C,D in a row differ significantly ($P < 0.05$)

Means with different superscripts a,b,c,d in a column differ significantly ($P < 0.05$)

N.S: Non-Significant & S: Significant

Haemoglobin

Pre-treatment (day 0) haemoglobin values were comparable among all groups with no significant differences. In the infected control group, haemoglobin levels decreased significantly from day 0 to day 21 as showed in table 5. In the fenbendazole-treated group, haemoglobin levels increased significantly from day 0 to day 7, day 14, and day 21. In the AEMK-treated groups, haemoglobin levels increased significantly from day 0 to day 7, day 14, and day 21, with greater improvement observed at the higher dose. Significant differences among groups were observed on day

7, day 14, and day 21, with all treated groups showing higher haemoglobin levels compared to the infected control group. The present findings were in agreement with Ahmed *et al.* (2015) [1], who reported a significant reduction in haemoglobin levels in gastrointestinal parasitic goats compared to normal animals. Similar improvement in haemoglobin levels following treatment had been documented by Gadhav (2018) [10], who observed a significant increase after administration of plant extracts. Comparable results were also reported by Ghormode *et al.* (2023) [11].

Table 5: Mean values+ SE of Haemoglobin in different experimental groups of goats. (n=10)

Groups	Treatment	Mean Hb (gm%) level $\pm$ SE				Stat
		0 Day	7 th Day	14 th Day	21 st Day	
I	Infected Control	7.66 $\pm$ 0.12 ^A	7.42 $\pm$ 0.14 ^{AB}	7.22 $\pm$ 0.16 ^{BB}	7.00 $\pm$ 0.15 ^{CB}	S
II	Fenbendazole	7.62 $\pm$ 0.19 ^C	8.20 $\pm$ 0.20 ^{AB}	8.65 $\pm$ 0.14 ^{aAB}	9.05 $\pm$ 0.15 ^{aA}	S
III	AEMK @1 g/kg BW	7.64 $\pm$ 0.25 ^B	7.90 $\pm$ 0.14 ^{aAB}	8.20 $\pm$ 0.16 ^{aAB}	8.45 $\pm$ 0.18 ^{bA}	S
IV	AEMK @ 2g/kg BW	7.59 $\pm$ 0.25 ^C	8.02 $\pm$ 0.13 ^{aBC}	8.52 $\pm$ 0.22 ^{aAB}	8.82 $\pm$ 0.12 ^{abA}	S
Stat		NS	S	S	S	

Total Erythrocyte Count (TEC)

The TEC values were comparable among all groups at day 0. The infected control group showed a gradual decline in TEC values from day 7 to day 21, with non-significant changes as showed in table no. 6. The fenbendazole-treated group showed a significant increase in TEC values from day 7 onwards, with progressive improvement up to day 21. Both AEMK-treated groups showed a significant rise in TEC values from day 7 onwards, with greater improvement observed at the higher dose. Significant differences among

groups were evident from day 7 onwards, with treated groups showing higher TEC values compared to the infected control group. The present findings corroborate the results of Rajput (2018) [28], who reported a significant increase in total erythrocyte count following treatment with fenbendazole and plant extracts. Comparable observations were reported by Moudgil *et al.* (2017) [23], who documented reduced TEC in parasitized goats, and by Ghormode *et al.* (2023) [11], who observed significant improvement in TEC following herbal treatment in helminth-infected goats

Table 6: Mean values+ SE of Total Erythrocytic count in different experimental groups of goats. (n=10)

Groups	Treatment	Mean TEC (10 ⁶ /μL) level $\pm$ SE				Stat
		0 Day	7 th Day	14 th Day	21 st Day	
I	Infected Control	8.11 $\pm$ 0.12	7.94 $\pm$ 0.13 ^b	7.76 $\pm$ 0.22 ^b	7.53 $\pm$ 0.24 ^b	NS
II	Fenbendazole	8.06 $\pm$ 0.11 ^D	8.82 $\pm$ 0.15 ^{aC}	9.38 $\pm$ 0.16 ^{aB}	10.28 $\pm$ 0.19 ^{aA}	S
III	AEMK @1 g/kg BW	8.18 $\pm$ 0.18 ^C	8.56 $\pm$ 0.12 ^{aC}	9.01 $\pm$ 0.11 ^{aB}	9.82 $\pm$ 0.18 ^{aA}	S
IV	AEMK @ 2g/kg BW	8.15 $\pm$ 0.15 ^C	8.62 $\pm$ 0.14 ^{aBC}	9.01 $\pm$ 0.13 ^{aB}	10.13 $\pm$ 0.23 ^{aA}	S

Packed Cell Volume (PCV)

The infected control group showed a slight decline in PCV values from day 7 to day 21, with nonsignificant changes. The fenbendazole-treated group showed a significant increase in PCV values from day 14 onwards, with

maximum improvement observed at day 21. Both AEMK-treated groups showed a significant rise in PCV values from day 14 onwards, with greater improvement at the higher dose. Significant differences among groups were observed at day 14 and day 21, with treated groups showing higher

PCV values compared to the infected control group. The present findings were in partial agreement with Moudgil *et al.* (2017) [23], who reported lower PCV values in parasitized goats, indicating its sensitivity as an indicator of parasitic severity. Similar improvement in PCV following treatment

had been documented by Rajput (2018) [28], who observed significant increases after administration of plant extracts, reflecting recovery from anaemia. Comparable results were also reported by Rathor (2023) [29], who noted a significant rise in PCV following polyherbal treatment in goats.

Table 7: Mean values+ SE of Packed cell volume in different experimental groups of goats. (n=10)

Groups	Treatment	Mean PCV (%) level $\pm$ SE				Stat
		0 Day	7 th Day	14 th Day	21 st Day	
I	Infected Control	21.62 $\pm$ 0.18	21.44 $\pm$ 0.21	21.31 $\pm$ 0.30 ^c	20.98 $\pm$ 0.28 ^c	NS
II	Fenbendazole	21.56 $\pm$ 0.27 ^C	21.91 $\pm$ 0.18 ^C	23.34 $\pm$ 0.13 ^{aB}	24.13 $\pm$ 0.09 ^{aA}	S
III	AEMK @1 g/kg BW	21.33 $\pm$ 0.21 ^B	21.78 $\pm$ 0.24 ^B	22.46 $\pm$ 0.19 ^{bA}	23.04 $\pm$ 0.27 ^{bA}	S
IV	AEMK @ 2g/kg BW	21.52 $\pm$ 0.21 ^C	22.04 $\pm$ 0.23 ^C	22.93 $\pm$ 0.26 ^{abB}	23.84 $\pm$ 0.21 ^{aA}	S
Stat		NS	NS	S	S	

Total Leucocyte Count (TLC)

The infected control group showed a progressive increase in TLC values from day 7 to day 21. The fenbendazole-treated group showed a significant decline in TLC values from day 7 onwards, with maximum reduction observed at day 21. Both AEMK-treated groups showed a significant decrease in TLC values during the post-treatment period, with greater reduction at the higher dose. Significant differences among groups were observed from day 7 onwards, with the infected control group showing higher TLC values compared to all

treated groups. The present findings were in agreement with Bordoloi *et al.* (2012) [4], who reported elevated total leucocyte count in helminthinfected animals due to parasitic infection. A decline in TLC following treatment, as observed in the present study, had also been reported by Kawdekar (2016) [18] after administration of Moringa oleifera extract. Similar trends were noted by Ghormode *et al.* (2023) [11], indicating improvement in leucocyte profile following therapeutic intervention in parasitized goats.

Table 8: Mean values+ SE of Total Leucocyte count in different experimental groups of goats. (n=10)

Groups	Treatment	Mean TLC (10 ³ / μ L) level $\pm$ SE				Stat
		0 Day	7 th Day	14 th Day	21 st Day	
I	Infected Control	8.21 $\pm$ 0.09 ^{cC}	8.34 $\pm$ 0.05 ^{abBC}	8.50 $\pm$ 0.08 ^{aB}	8.75 $\pm$ 0.08 ^{aA}	S
II	Fenbendazole	8.55 $\pm$ 0.06 ^{bA}	8.26 $\pm$ 0.06 ^{bB}	7.88 $\pm$ 0.04 ^{dC}	6.93 $\pm$ 0.07 ^{dD}	S
III	AEMK @1 g/kg BW	8.74 $\pm$ 0.04 ^{aA}	8.44 $\pm$ 0.04 ^{aB}	8.19 $\pm$ 0.03 ^{bC}	7.87 $\pm$ 0.03 ^{bD}	S
IV	AEMK @ 2g/kg BW	8.86 $\pm$ 0.03 ^{aA}	8.47 $\pm$ 0.03 ^{aB}	8.05 $\pm$ 0.02 ^{cC}	7.28 $\pm$ 0.04 ^{cD}	S
Stat		S	S	S	S	

Serum Total Protein

The infected control group showed a significant decline in total protein levels from day 7 to day 21. The fenbendazole-treated group showed a significant increase in total protein levels from day 7 onwards, with maximum improvement at day 21. Both AEMK-treated groups showed a significant rise in total protein levels during the post-treatment period, with greater improvement at the higher dose. Significant differences among groups were observed at day 14 and day 21, with treated groups showing higher total protein levels

compared to the infected control group. The findings were in agreement with Bordoloi *et al.* (2012) [4] and Ahmed *et al.* (2015) [1], who reported reduced total protein levels in helminth-infected goats. Improvement in total protein following treatment, as observed in the present study, has also been documented by Panchal (2016) [25] using polyherbal formulations. Similar enhancement in total protein levels after herbal treatment was reported by Jain and Sahni (2010) [16].

Table 9: Mean values+ SE of Serum Total Protein in different experimental groups of goats. (n=10)

Groups	Treatment	Mean TP (g/dl) level $\pm$ SE				Stat
		0 Day	7 th Day	14 th Day	21 st Day	
I	Infected Control	6.64 $\pm$ 0.11 ^A	6.49 $\pm$ 0.08 ^A	6.13 $\pm$ 0.07 ^{Cb}	6.06 $\pm$ 0.12 ^{cB}	S
II	Fenbendazole	6.18 $\pm$ 0.19 ^C	6.67 $\pm$ 0.14 ^B	7.23 $\pm$ 0.11 ^{aA}	7.52 $\pm$ 0.07 ^{aA}	S
III	AEMK @1 g/kg BW	6.48 $\pm$ 0.11 ^C	6.68 $\pm$ 0.10 ^{BC}	6.94 $\pm$ 0.09 ^{bAB}	7.02 $\pm$ 0.08 ^{bA}	S
IV	AEMK @ 2g/kg BW	6.27 $\pm$ 0.15 ^C	6.77 $\pm$ 0.13 ^B	7.06 $\pm$ 0.07 ^{abAB}	7.28 $\pm$ 0.07 ^{abA}	S
Stat		NS	NS	S	S	

Serum Alanine Aminotransferase (ALT)

The infected control group showed a gradual increase in ALT levels from day 7 to day 21, with non-significant changes. The fenbendazole-treated group showed a significant reduction in ALT levels from day 7 onwards, with maximum decline observed at day 21. Both AEMK-treated groups showed a gradual decrease in ALT levels during the experimental period, although the changes were non-significant. Significant differences among groups were

observed at day 21, with treated groups showing lower ALT levels compared to the infected control group. The findings indicated a reduction in ALT levels in treated groups, remaining within normal physiological limits, suggesting hepatic safety of the treatments. Similar observations had been reported by Rajput (2018) [28] and Kawdekar (2016) [18], where ALT values remained within normal range following herbal treatment. Comparable results were also documented by Panchal (2016) [25], indicating reduced ALT

levels without hepatic damage. Findings of the present study are also in agreement with Hafiz *et al.* (2020) ^[13], Nayak *et al.* (2021) ^[24], and Rehman *et al.* (2020), who reported mild

alterations or nonsignificant changes in ALT levels in parasitized goats and following herbal treatment.

Table 10: Mean values+ SE of Serum Alanine Aminotransferase in different experimental groups of goats. (n=10)

Groups	Treatment	Mean ALT (IU/L) level $\pm$ SE				Stat
		0 Day	7 th Day	14 th Day	21 st Day	
I	Infected Control	31.16 $\pm$ 2.53	32.74 $\pm$ 1.23	34.35 $\pm$ 1.67	35.45 $\pm$ 1.39 ^a	NS
II	Fenbendazole	35.50 $\pm$ 0.78 ^A	32.66 $\pm$ 1.93 ^{AB}	29.93 $\pm$ 1.11 ^{BC}	27.80 $\pm$ 1.23 ^{BC}	S
III	AEMK @1 g/kg BW	33.39 $\pm$ 2.58	32.82 $\pm$ 2.76	31.54 $\pm$ 2.18	30.44 $\pm$ 1.61 ^b	NS
IV	AEMK @ 2g/kg BW	34.74 $\pm$ 2.83	32.16 $\pm$ 1.83	30.85 $\pm$ 2.00	29.16 $\pm$ 1.62 ^b	NS
Stat		NS	NS	NS	S	

Serum Aspartate Aminotransferase (AST)

The infected control group showed a slight increase in AST levels from day 7 to day 21, with nonsignificant changes. The fenbendazole-treated group showed a gradual decline in AST levels during the experimental period, although the changes were non-significant. Both AEMK-treated groups showed a mild decrease in AST levels from day 7 onwards, with non-significant variations. No significant differences among groups were observed at any time point, indicating

minimal treatment effect on AST levels. The findings were in agreement with Hafiz *et al.* (2020) ^[13] and Nayak *et al.* (2021) ^[24], who reported increased AST levels in parasitized goats, indicating infection-related changes. In the present study, AST levels showed stabilization following treatment. Similar observations have been reported by Kawdekar (2016) ^[18] and Rajput (2018) ^[28], where AST levels remained within normal physiological limits following herbal treatment, indicating hepatic safety.

Table 11: Mean values+ SE of Serum Aspartate Aminotransferase in different experimental groups of goats. (n=10)

Groups	Treatment	Mean AST (IU/L) level $\pm$ SE				Stat
		0 Day	7 th Day	14 th Day	21 st Day	
I	Infected Control	86.81 $\pm$ 9.68 ^{aA}	90.17 $\pm$ 11.36 ^{aA}	94.72 $\pm$ 8.10 ^{aA}	100.99 $\pm$ 5.63 ^{aA}	NS
II	Fenbendazole	96.33 $\pm$ 8.84 ^{aA}	87.80 $\pm$ 9.53 ^{aA}	76.67 $\pm$ 4.25 ^{aA}	71.37 $\pm$ 7.80 ^{aA}	NS
III	AEMK @1 g/kg BW	88.66 $\pm$ 9.68 ^{aA}	85.16 $\pm$ 8.63 ^{aA}	84.49 $\pm$ 9.27 ^{aA}	82.90 $\pm$ 8.08 ^{aA}	NS
IV	AEMK @ 2g/kg BW	90.77 $\pm$ 7.02 ^{aA}	84.69 $\pm$ 10.33 ^{aA}	80.18 $\pm$ 9.52 ^{aA}	76.49 $\pm$ 9.71 ^{aA}	NS
Stat		NS	NS	NS	NS	

Conclusion

The present investigation concluded that the aqueous leaf extract of *Murraya koenigii* Linn. possesses moderate dose-dependent anthelmintic activity against naturally acquired gastrointestinal parasites in goats. The extract at 2 g/kg body weight achieved 67.57% faecal egg count reduction along with significant improvement in haematological parameters (haemoglobin, TEC and PCV) and serum biochemical parameters (total protein and globulin) without any evidence of hepatotoxicity. Phytochemical analysis revealed the presence of alkaloids, tannins and flavonoids, which are likely responsible for the observed efficacy. The findings scientifically validate the traditional use of *M. koenigii* leaves and suggest that its aqueous leaf extract can serve as a safe, cost-effective and eco-friendly herbal alternative ("green dewormer") for integrated parasite management in goats, particularly in the era of widespread anthelmintic resistance.

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