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In *Vivo* Activity of Crude Aqueous Methanolic Extract of *Musa Paradisiaca* Against Gastrointestinal Nematodes in Sheep

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ABSTRACT

An experimental study was conducted from January to August 2018 in Mekelle to evaluate the *in vivo* anthelmintic activity of crude aqueous methanolic extract of *Musa paradisiaca* leaves against mixed gastrointestinal nematodes in sheep. The animals were divided into two groups: Group A (n = 4) for acute toxicity testing and Group B (n = 16) for the main experiment. Group B was further subdivided into four groups (n = 4 each) based on fecal egg count. The first two groups received the plant extract at doses of 200 and 600 mg/kg, respectively; the third group was treated with Albendazole at 7.5 mg/kg; and the fourth group served as an untreated control. Anthelmintic activity was assessed using fecal egg count reduction, larval count, packed cell volume, live body weight, and total worm count before and after treatment. The highest reduction in eggs per gram of feces was 68% and 65.8% at 200 and 600 mg/kg, respectively, on day 12 post-treatment. Larval count reductions were 60.2% and 57.2% at the lower and higher doses, respectively. The extract had no significant effect on PCV or body weight. Post-mortem results showed high efficacy against male *Ostertagia triuracata* and *Ostertagia circumcincta*, but no effect on male *Ostertagia (Marshalgia) marshalli* and female *Haemonchus contortus*. Overall, *Musa paradisiaca* demonstrated moderate *in vivo* anthelmintic activity, with greater efficacy against male than female worms. These findings suggest its potential as an alternative treatment option in areas with high drug resistance and residue concerns.

Keywords: Gastro-intestinal nematodes, *Musa paradisiaca,* Sheep.

1. INTRODUCTION

Livestock are essential to the livelihoods of low-income farmers, offering economic benefits, social value, and food security. Based on 2010 figures, global demand for meat and milk is projected to rise by 73% and 58% respectively, by 2050 (Kimani et al., 2014). Sheep are raised globally on both family farms and commercial operations, providing meat, milk, wool, and hides (Torres-Acosta and Hoste, 2008). Ethiopia ranks second in Africa and sixth globally in sheep population, with approximately 30.70 million sheep and 30.20 million goats (CSA, 2017).

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Although the phylum Nemathelminthes consists of six classes, only one, Nematoda, includes parasitic species of significance. Nematodes, which belong to the Nemathelminthes group, encompass several superfamilies that are important in veterinary medicine (Taylor et al., 2015). Commonly known as roundworms, nematodes have a cylindrical shape and are covered by a colorless outer layer called the cuticle. Their digestive system includes a mouth, esophagus, and intestinal tract, ending in an anus in females and a cloaca in males (Maggenti, 2012). Clinical symptoms in sheep typically include anemia, edema, weight loss, and lowered hematocrit levels, which are often associated with nematode infestations (Van Wyk and Bath, 2002).

Gastrointestinal nematode infections are the most commonly encountered parasitic diseases in tropical and subtropical regions (Githiori et al., 2004). These infections are particularly prevalent in small ruminants (Abebe et al., 2010). Gastrointestinal nematode infections hinder growth and reproductive performance and contribute to higher mortality rates (Vieira, 2003). As noted by Eguale et al. (2007), gastrointestinal nematode infections lead to 28% mortality and 8% weight loss in sheep, especially in developing countries with low socioeconomic status and poor management practices. Infected animals also produce lower-quality wool, meat, and milk due to the associated clinical symptoms (Saddiqi et al., 2012).

Parasitic infections significantly limit livestock productivity due to related morbidity and mortality (Tibbo et al., 2005; Nwosu et al., 2007). Helminthosis is responsible for 28% of mortality and 3–8% of weight loss in Ethiopian highland sheep, and the financial loss from helminthosis is estimated at 700 million Ethiopian Birr and US$81.8 million annually (Adamu et al., 2010; Biffa et al., 2006).

Most parasite control programs combine chemotherapeutic methods, grazing management, dietary changes, biological control, vaccination, and ethno-veterinary treatments (Muluneh et al., 2014). However, chemotherapeutic methods face issues like drug resistance, toxicity, high treatment costs, and lack of access in remote areas (Hussain et al., 2010). These challenges have driven research into alternative treatments for helminthiasis (Iqbal et al., 2003). With increasing drug resistance, plants have gained attention for their efficacy and cost-effectiveness in treating parasites (Klimpel et al., 2011). Herbal medicine has long been a key part of traditional veterinary practices (Iqbal et al., 2004).

Herbal medicine has long played an important role in traditional veterinary practice (Iqbal et al., 2004), and in Ethiopia it continues to be widely relied upon due to limited access to modern pharmaceuticals and the increasing prevalence of drug-resistant parasitic

infections. Although several studies have investigated the anthelmintic potential of medicinal plants (Kuma et al., 2015), only a few have been scientifically validated, creating a significant knowledge gap regarding their efficacy, particularly against gastrointestinal nematodes in sheep. Addressing this gap is important, as it may contribute to the development of affordable and sustainable alternative treatments, thereby supporting both local and national livestock production systems. Therefore, this study aims to evaluate the *in vivo* anthelmintic efficacy of *Musa paradisiaca* by assessing its effect on faecal egg count reduction, determining associated changes in packed cell volume and live body weight, and examining its effectiveness against both adult and larval stages of gastrointestinal nematodes.

2. MATERIALS AND METHODS

2.1. Study Area

The study was conducted at the Parasitology and Pharmacognosy laboratories of the College of Veterinary Medicine and College of Health Sciences of Mekelle University, Mekelle, the capital city of Tigray regional state, located at 783 km North of Addis Ababa at 39° 29`E and 13° 30` N and an altitude of 2000 m a. s. l. (BoPED, 2011). Sheep population in the Tigray region is estimated at about 2,041,731 (CSA, 2017).

2.2. Study Design

An experimental study design was employed from January to August 2018. Faecal samples were collected from 75 sheep (≤1.5 years old, weighing 8–19 kg) in Southern Tigray (Hashenge) for the selection of experimental animals. Sheep were tagged for identification, and microscopic examination and faecal egg count (FEC) were performed using the flotation method and McMaster technique (Khan et al., 2010). Sixteen sheep showing mixed gastrointestinal nematodes with an EPG >500 were selected and purchased. These sheep were used to determine the anthelmintic effect of crude aqueous methanolic extract of *Musa paradisiaca* leaves on sixteen naturally infected sheep.

2.3. Plant Materials Collection and Preparation

Fresh leaves of Musa species, ranging from 1 to 2 meters in length, were collected in January 2018 from the Western Tigray region, specifically from an area called ‘Tekeze,’ located about 425 km northwest of Mekelle. To prevent drying, the leaves were wrapped in plastic sheets during transportation. The plant samples were identified as *Musa paradisiaca* by a taxonomist at the Herbarium in the Department of Biology, Addis Ababa University, with voucher Herbarium No. 321. The leaves were washed with tap water to remove any debris, then chopped manually along the direction of the fibers in an open shed. The leaves were

dried at room temperature following the method outlined by Gregory et al. (2015). After drying, the leaves were ground using a micro plant grinder (FZ102, England) at the pharmacognosy laboratory of the College of Health Sciences, Mekelle University.

2.4. Extract Preparation and Preliminary Phytochemical Screening

The plant extract was prepared using the method outlined by Gilani et al. (2005). Powdered plant material was soaked in a 1:5 ratio of 70% aqueous methanol through cold maceration at room temperature for 3 days. The filtrate was collected by repeatedly soaking the plant material in muslin cloth and then concentrated using a rotary evaporator at 40°C under reduced pressure, followed by drying in a vacuum oven. The concentrated *Musa paradisiaca* leaf extract was stored at 4°C until needed. Preliminary qualitative screenings for major secondary metabolites were conducted according to the procedures of Debella (2002), and the extract tested positive for saponins, flavonoids, condensed tannins, phenolic compounds, and alkaloids. Finally, the extract was transferred to bottles with tight-fitting caps, labelled with the plant name, and refrigerated at 4°C until use in the anthelmintic study.

2.5. Acute Toxicity Test

The acute toxicity of the crude plant extracts was assessed in sheep using the procedure outlined by Pour, et al. (2011). Four female sheep were purchased and marked for identification, then randomly divided into control (n=1) and treatment (n=3) groups. They were fasted for approximately 12 hours and 4 hours before dosing, with access to water being restricted for the treatment group. The control group received distilled water, while the treatment group was given the concentrated Musa paradisiaca leaf extract orally, at doses of 5000mg/kg (n=1) and 2000mg/kg (n=2), dissolved in distilled water. Clinical data and mortalities were monitored for 7 days following treatment. Postmortem examinations were conducted on sheep that exhibited acute toxicity symptoms, following the method described by Jackman and Hathaway (2010).

The first sheep, dosed with 5000mg/kg of the concentrated extract, was euthanized due to severe toxicity signs, including difficulty breathing, pain, groaning, and frequent urination within the first four hours of treatment. Pathological changes such as white spots, congestion, hemorrhaging, and shrinkage in the liver, kidneys, and intestines were observed, indicating acute toxicity. The second sheep, dosed with 2000mg/kg, showed no toxicity signs and resumed feeding 3–4 hours post-treatment. Similarly, the third sheep, dosed with the same amount, also showed no toxicity signs. Based on these results, 2000mg/kg was established as the limit dose for the experiment.

2.6. Study Animal and Treatment

The sheep were tagged, provided with coast-cross hay (Cynodon dactylon) and concentrate, and given ad libitum access to water. They were treated with Diazinon for external parasite control and kept in disinfected pens for 14 days to acclimatize before the experiment. The 16 sheep were divided into four groups of four based on FEC results from the day before the trial (Khan et al., 2010). The groups were assigned to the following treatments: 200 mg/kg CAME *Musa paradisiaca* (group 1), 600 mg/kg CAME Musa paradisiaca (group 2), 7.5 mg/kg Albendazole (positive control) (group 3), and untreated control (group 4). All groups were housed in separate pens at the sheep and goat research unit, College of Veterinary Medicine, Mekelle University.

The plant extract was administered via a stomach tube dissolved in distilled water, while Albendazole was given with a balling gun. All groups were provided with coast-cross hay, wheat bran concentrate, and water. Fecal samples were collected pre-treatment (day 0) and on days 3, 6, 9, 12, and 15 post-treatment. FEC was performed using the McMaster technique (Thienpont et al., 1986) and expressed as eggs per gram (EPG) to assess the anthelmintic effects of Musa paradisiaca.

2.7. Parasitological Techniques

2.7.1. Fecal Examination

Approximately 3 grams of sheep feces were placed in a mortar, and 42 ml of sodium chloride (NaCl) solution was added before macerating with a pestle. The mixture was filtered through a sieve and poured into a test tube, which was left for 20 minutes to allow a convex meniscus to form. A cover slip was placed on top to collect the nematode eggs based on their specific gravity. The cover slip was then examined under a microscope (x4 or x10 magnification) for nematode eggs.

To determine the eggs per gram (EPG), the McMaster technique (Thienpont et al., 1986) was used. Four grams of feces were crushed and suspended in 10 ml of water, then mixed with 56 ml of saturated sodium chloride solution. The suspension was filtered through a tea sieve into a flask and stirred to ensure even distribution of eggs. A sample was taken using a Pasteur pipette to fill the counting chambers of a McMaster slide. After letting the slide sit for 5 minutes to allow the eggs to float, it was examined under a microscope at low magnification. The eggs in both chambers were counted, and eggs per gram (EPG) was calculated using the formula:

$$EPG = (\text{number of eggs in the two chambers}/2)\ 100$$

2.7.2. Body Weight Measurement and Packed Cell Volume Determination

Packed cell volume and live body weights were assessed at day zero (pre-treatment) and days of +7 and +14 post-treatment. The body weights of all experimental sheep were recorded using a portable measuring balance. PCV values were determined by micro hematocrit centrifugation technique (Hansen and Perry, 1994). Blood was collected in heparinized vacutainers and filled in a micro hematocrit tube by capillary action. Then it was centrifuged at 11,000rpm for 5 minutes. The PCV percent was read using a hematocrit reader.

2.7.3. Larvae Counting

Fecal samples were collected and cultured for larvae counting before and after treatment, on each sampling day, for each treatment group. After incubating for 10 days at 27^0C third stage larvae were recovered by the Baerman technique according to Thienpont et al. (1986); and Hansen and Perry (1994).

2.7.4. Necropsy Worm Counts and Identification

After 14 days of follow-up, experimental sheep were sacrificed, and gastrointestinal contents and mucosae were collected for total worm counts. The abomasum, small intestine, and large intestine were separated by binding at the two ends and different junctions between organs (Graber and Perrotin, 1983; Kaufmann and Kennedy, 1996). Each delimited compartment was opened longitudinally. Contents were collected under tap water in a bucket and passed through a sieve (150 μm). The residues were spilled in another bucket, and 2 L of water were added. The suspension was homogenized; 200 ml was taken for a systematic identification and counting of parasites with an optical microscope (Gx100). The corresponding numbers of adult worms counted in 2 L were arithmetically calculated. The adult worms were identified by features according to Taylor et al. (2015).

2.8. Data Management and Analysis

The change in mean FEC was calculated according to the following formula set by Robertson et al. (2016).

$$FECRT\ (\%) = (MEPGpret - MEPGpostt)\ 100$$

Where, FECRT = faecal egg count reduction test, MEPG = mean egg per gram of faeces, pret= pretreatment, postt=posttreatment.

The percent efficacy (%E) of treatment was expressed using the following formula:

$$\%E = ((Mc - Mx)/Mc)\ 100$$

Where, Mc = mean of adult worms in the negative control group (4); Mx = mean of adult worms in treated groups (1 or 2) or positive control (3).

According to Marchiondo et al. (2007) extract has considered as highly effective if %E>90 %; moderately effective if %E=80–90 %; and low efficacy if %E=60–80 %. Efficacies less than 60 % are considered ineffective.

Mean EPG, PCV, and LBW of groups of sheep at different days, and mean worm burden at necropsy were compared with the control group by ANOVA and Regression. T-Test was analyzed before treatment and after treatment of larvae counting, PCV and LBW. All statistical analysis was performed by STATA Version 13.0 considered significant at $p < 0.05$, and Excel was used to generate tables and graphs.

3. RESULTS

3.1. Effect of *M. paradisiaca* on Fecal Egg Count

Maximum FECRT (%) was recorded on day 12 PT at dose rates of 200 and 600mg/kg b.w of *M. paradisiaca* leaves extract, which were 68% and 65.8% respectively. However, Albendazole showed 100% FECRT on day 3 PT, which was maintained until day 12, followed by 84.8% on day 15 PT (Fig 1). Lower and higher doses of *M. paradisiaca* exhibited strong ($P < 0.001$) anthelmintic activity vis-à-vis untreated control in all days' PT except on day 15. On day 15 PT, a higher dose of *M. paradisiaca* ($p < 0.05$) and a lower dose of *M. paradisiaca* ($p \leq 0.01$) reduced EPG significantly (Table 1).

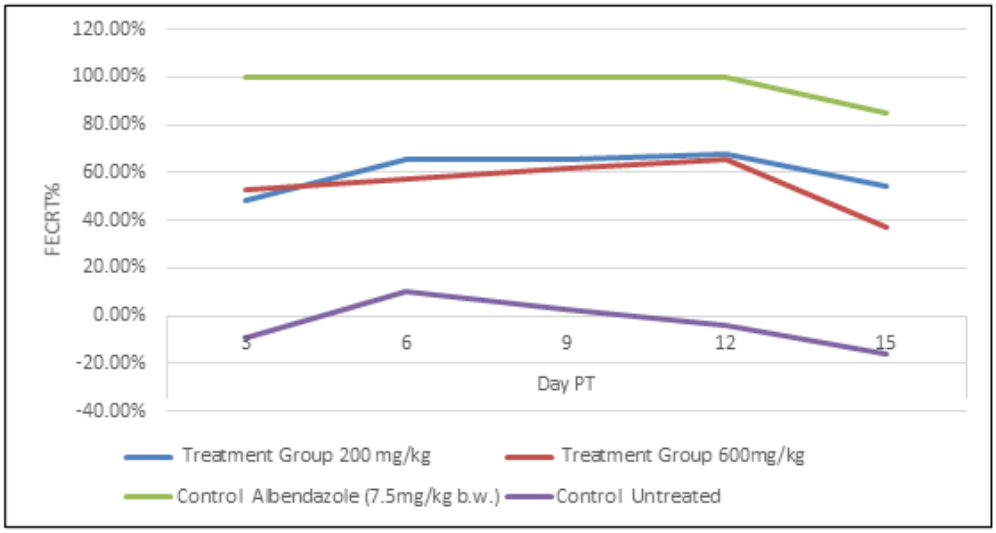


Figure 1. Faecal egg count reduction test (FECRT %).

3.2. Effect of *M. paradisiaca* on PCV

The PCV values of the experimental sheep after intervention showed a non-significant ($P > 0.05$) decrease across all treatment groups on day 14. On day 7, the group treated with a

lower dose of M. paradisiaca exhibited an insignificant (P > 0.05) increase in PCV values. No significant differences were observed among the groups (Table 2).

3.3. Effect of *M. paradisiaca* on Live Body Weight

The mean LBW of the sheep group treated with a higher dose of M. paradisiaca and the untreated group decreased significantly ($p < 0.05$) by day 14 post-treatment. In contrast, the group treated with a lower dose showed a non-significant increase ($p > 0.05$) on day 14 post-treatment. Significant difference is observed between the groups on days 0 and 14 (Table 3).

Table 1. EPG counts of sheep treated with different doses of CAME M. paradisiaca and Albendazole.

Days	***M. paradisiaca extract dose (mg/kg b.w.)***		***Controls***	
	200	***600***	***Albendazole (7.5mg/kg b.w.)***	***Untreated***
0BT	900 ± 402.08	912.5±295.45	825 ±184.84	975±125.83
3PT	462.5±332.60***	425 ±332.92***	0 ± 0 ***	1062.5 ±47.87
6 PT	312.5 ± 242.81***	387.5±301.04***	0 ±0***	1075 ±64.55
9 PT	312.5 ± 232.29***	350±310.91***	0±0 ***	950 ±70.71
12 PT	287.5 ± 209.66***	312.5 ±306.53***	0 ±0***	1012.5 ±75
15 PT	437.5 ± 335.10**	575±480.45*	125±165.83***	1137.5 ±188.74

Note: *p < 0.05; **p ≤ 0.01; ***p < 0.001. Mean±S.E.M, BT: before treatment; PT: post treatment.

Table 2. Mean PCV % value of against different doses of the plant and specific dose of Albendazole.

Days	***M. paradisiaca dose (mg/kg b.w.)***		***Controls***	
	200	***600***	***Albendazole (7.5mg/kg b.w.)***	***Untreated***
0BT	28.5 ± 1.290994	23.25 ± 6.946222	28.25± 2.362908	27 ± 2.160247
7PT	29.25 ± .9574271	23.25± 6.849574	26 ± 2.581989	26.25± 1.5
14PT	26.625 ±3.092329	21.875± 7.465197	26.25 ± 2.5	26 ± 2.160247

Note: Consider significant difference at p < 0.05, Mean ± S.D, BT: before treatment; PT: post treatment.

Table 3. Mean live weight (kg) of sheep treated with M. paradisiaca and Albendazole.

Days	***M. paradisiaca dose (mg/kg b.w.)***		***Controls***	
	200	***600***	***Albendazole (7.5mg/kg b.w.)***	***Untreated***
0 BT	14.5±3.89444	14.75 ± 4.25245	12±3.188521	10.5±3.109126
7 PT	15.5±2.198484	11.5 ±3.741657	12.75±4.092676	8±2.415229
14 PT	14.75±4.112988	13.375±4.308422*	11.75±2.723356	7.375±1.796988*

Note: *means with significant difference at p < 0.05, Mean ± S.D, BT: before treatment; PT: post treatment.

3.4. Effect *of M. paradisiaca* on Larvae Count

As shown in table 4, the number of larvae in the feces of experimental sheep decreased by 60.2%, 57.2%, and 71.8% following treatment with 200 mg/kg and 600 mg/kg doses of M.

paradisiaca, and Albendazole, respectively. However, these reductions were not statistically significant ($p > 0.05$) (Table 4).

Table 4. Mean larvae count and standard deviation (SD) in experimental sheep of the medicinal plant and Albendazole.

Groups	***BT***	***PT***	***p Value***
M. paradisiaca treated group I (at dose of 200mg/kg b.w.)	88.5 ± 35.8713	35.25 ± 14.86256	0.3164
M. paradisiaca treated group II (at dose of 600mg/kg b.w.)	126.25± 21.95592	54 ±39.14929	0.1847
Positive control (treated with Albendazole)	133.25 ± 40.8929	37.5 ± 37.5	0.0839
Negative control (untreated)	360 ± 214.515	60.75 ± 32.23708	0.2024

Note: Consider significant difference at $p < 0.05$, BT: before treatment; PT: post treatment.

3.5. Efficacy of *M. paradisiaca* on Worm Burden

The highest efficacy was recorded in adult male *Ostertagia triuracata* (100%) and Strongyloides spp. (80%) at a lower dose of *M. paradisiaca.* The highest efficacy was also recorded for male Ostertagia circumcincta (100%) and Cooperia spp. (83.3%) at a higher dose of *M. paradisiaca.* However, the lowest efficacy was recorded on male *Ostertagia marshal* (-75) and male *Ostertagia circumcincta* (-50), followed by female *Haemonchus contortus* (-40) at doses of 200mg and 600mg *M. paradisiaca*, respectively (Table 5).

Table 5. Percentage efficacy of worm burden on day 15 using the medicinal plant and Albendazole.

Species	***M. paradisiaca (200mg/kg)***		***M. paradisiaca (600mg/kg)***		***Albendazole***	
	Female (%)	***Male (%)***	***Female (%)***	***Male (%)***	***Female (%)***	***Male (%)***
Haemonchus contortus	10	50	-40	0	100	100
Ostertagia trifurcata	0	100	0	0	0	100
Ostertagia circumcicta	0	-50	0	100	0	100
Ostertagia (Marshalgia) marshalli	0	-75	0	25	0	100
Trichostrongylus colubriformis	20	20	60	60	80	80
Strongyloides spp.	66.7	80	33.3	60	33.3	60
Oesophagostomum spp.	50	60	25	40	100	100
Cooperia spp.	50	40	83.3	80	100	100

4. DISCUSSION

This in *vivo* scientific validation of *M. paradisiaca* showed promising anthelmintic activity as screened through (FECRT, PCV, LBWS, worm burden reduction, and Larval Counts) assays in view of its usage in ethnoveterinary practices in Ethiopia. The probable reason for its

potent anthelmintic activity may be due to the constituents, including alkaloids, saponins, flavonoids, condensed tannins, and phenolics. Anthelmintic activity of various phytochemicals, including saponins (Fakae et al., 2000), alkaloids (Lateef et al., 2003), and tannins (Molan et al., 2000; Iqbal et al., 2007) strongly supported this speculation. Moreover, in the scientific literature, there are many reports of FEC decrease in sheep treated with plants rich in condensed tannins (Lange et al., 2006; Marley et al., 2003; Nery et al., 2010).

The present findings are consistent with studies by Gregory et al. (2015), which reported significant reductions in fecal egg count (FEC) in animals fed banana leaves. Similarly, Furtado (2006) observed lower FEC in lambs fed banana foliage, while Hussain et al. (2011) reported an 80.7% reduction using Musa paradisiaca extract, although this was lower than the 97% reduction achieved with Levamisole, possibly due to breed differences. In contrast, Nogueira et al. (2012); and Gregory et al. (2015) found no significant effects on FEC, suggesting that variations may be related to differences in plant type or maturity.

In this study, M. paradisiaca showed no statistically significant effect on packed cell volume (PCV), although values remained within the normal range (Bezerra et al. 2008). The gradual increase in PCV may be attributed to natural hemopoiesis, increased water intake, or a possible lack of stimulatory effect of the plant on the hematopoietic system (Githiori, 2004). Consistent with this, previous studies also reported that medicinal plant treatments did not significantly improve hematological parameters in infected animals (Eguale et al., 2007; Bizimenyera et al., 2008; Gregory et al., 2017).

In this study, *M. paradisiaca* did not significantly increase the body weight of treated animals, possibly due to variations in feed intake and competition. The short observation period limited conclusions about long-term effects on weight gain. This aligns with Gregory et al. (2017), who also reported no significant weight change in sheep infected with *H. contortus* and *T. colubriformis* treated with banana leaf. However, other studies have shown weight improvement following plant extract treatments, likely due to improved mineral profiles and protein utilization. Condensed tannins in the extracts may protect dietary proteins from rumen degradation, enhancing amino acid absorption and supporting weight gain and immune responses (Barry et al., 2001; Iqbal et al., 2007; Kimani et al., 2014; Min and Hart, 2003; Niezen et al., 2002).

The treatment of nematode-infected sheep with the *M. paradisiaca* extract resulted in decrease in larval count after treatment. However, the reduction is statistically insignificant ($P>0.05$). This probably implies that the extracts were effective in mature parasites but not young stages, and this fact may be due to the short period of administration of *M. paradisiaca*

leaves. This is opposite with, the result reported by Nogueira et al. (2012) which was 96.97% efficacy. This difference could be due to in *vitro* screed and in *vivo* used in this study. Marie-Magdaleine et al. (2010) have suggested that Musa spp. has anthelmintic properties, as evidenced by its ability to significantly reduce and inhibit *T. colubriformis* larval hatchability in *vivo*. This variation may be due to using different breeds and methodologies.

In this study, male worms were more susceptible to *M. paradisiaca* and Albendazole compared to females. Significant ($p < 0.05$) reduction of Cooperia spp. was observed higher dose of *M. paradisiaca* when compared with the untreated group. Albendazole was recorded significant reduction in both sexes of Oesophagostomum spp, Cooperia spp., *Trichostrongylus colubriformis* and *H.contortus*. According to Marchiondo et al. (2007) extract is highly effective if %E>90 %; moderately effective if %E=80–90 %; and low efficacy if %E=60–80 %. Efficacies less than 60 % are considered ineffective. Therefore, the percentage efficacy of 200mg/kg and 600mg/kg of *M. paradisiaca* in the present study was highly effective in the case of males of *Ostertagia triuracata* and *Ostertagia circumcincta*, when moderately effective in both sexes of *Cooperia spp.* and *Strongyloides spp.* (male).

Plant extracts with low in *vivo* effectiveness may still be relevant for the control of multi-resistant nematode populations (Nogueira et al., 2012). *M. paradisiaca* shows significant anthelmintic activity against nematodes (Yemele Bouberte et al., 2006). These are generally similar to the present study. The efficiency of the *M. paradisiaca* extract at a dose of 200mg/kg against *Haemonchus contortus* (male) was 50%. The mean worm count in the Albendazole-treated group (positive control) showed that albendazole is very effective in controlling the *Haemonchus contortus* worms as compared to *M. paradisiaca*. The results shown for albendazole agreed with those reported by Komba (2013).

4.1. Limitations of the Study

Limitation of the study is that the anthelmintic efficacy of *Musa paradisiaca* leaf was not evaluated at the in vitro screening level, and the potential influence of breed on resistance was not taken into account.

5. CONCLUSION AND RECOMMENDATIONS

The increasing concerns over anthelmintic resistance and the environmental impact of conventional drugs have led to a growing interest in novel plant-based alternatives. The current study on Musa paradisiaca leaves as a treatment for gastrointestinal nematodes in sheep demonstrated promising results, with reductions in fecal egg counts, larvae, and adult worm burden, particularly among male worms. However, it had minimal effects on packed

cell volume (PCV) and live body weight (LBW) and no observed toxic effects. Based on these findings, *M. paradisiaca* shows potential as a treatment for gastrointestinal nematodes in sheep. It is recommended that further studies focus on isolating and identifying the active compounds in *Musa paradisiaca* leaves, and long-term safety trials must be conducted to assess potential side effects. Additionally, *M. paradisiaca* may be promoted as an eco-friendly solution for parasite management, and future research should evaluate the optimal dosage and administration methods for effective parasite control.

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7. CONFLICT OF INTEREST

The authors declare no conflict of interest for this study.

DECLARATIONS

Ethical considerations

Ethical clearance was obtained from Mekelle University's College of Veterinary Sciences ethical review board with an AEEC No: AEEC3/2017.

Clinical trial number

We don't have a clinical trial number yet, but we are making progress.

8. REFERENCE

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