IN-VITRO ANTIHELMINTIC EFFECTS OF TWO KENYAN PLANT EXTRACTS AGAINST HEAMONCHUS CONTORTUS ADULT WORMS

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Abstracts

This study was on evidence based information that Entada leptostachya Harms and Rapanea rhododendroides (Gil) Mez were used by the herbalists in Mbeere County, Kenya, for the treatment of gastrointestinal worms. The plants’ aqueous and solvent extracts were tested for their in-vitro antihelmintic activity against Haemonchus contortus adult worms. Of the eight plant extracts investigated, four extracts exhibited adult worm mortality greater than 50% while the other four afforded mortality ranging between 60-77%. E. leptostachya methanol extract was the most active (77%). Albendazole was used as a positive control drug while Goodwin’s physiological solution was used as negative control. Methanol extracts for both plants exhibited the highest anthelmintic activity at the test concentrations of 25mg/ml. Although R. rhododendroides was ranked third in general usage by the herbalists, E. leptostachya was solely used for the treatment of intestinal worms. The present results demonstrated that E. leptostachya and R. rhododendroides plant extracts had anthelmintic agents, and justified their traditional use as alternative drugs for the treatment of heamonchosis in ruminants

Keywords: Heamonchosis, Herbalists, Mbeere, Tannins, Saponins, Entada leptostachya

1. Introduction

Gastrointestinal (GI) nematodes are a major threat to sheep productivity and endanger animal welfare Worldwide particularly in developing countries¹. Haemonchosis has been identified as one of the top ten constraints to sheep and goat rearing in East Africa² and is the leading pathogenic and resistant helminth parasite in small ruminants that causes acute and high mortality³. Control of gastrointestinal helminths by use of synthetic anthelmintics has inherent challenges to the poor farmers of developing countries⁴. Furthermore, continuous usage of conventional anthelmintics leads to development of resistance, presence of residues in meat and milk with associated high environmental impact⁵. Resistance of H. Contortus to ivermectin and benzimidazoles has been reported, the parasite the occurrence being significantly higher in sheep than in goats ⁶,⁷. Anthelmintic resistance and other associated shortcomings of conventional drugs has necessitated search for alternative herbal remedies⁸. In-vitro activity of plant extracts against H. contortus adult worms, larval development and hatching has been demonstrated⁹,¹⁰,¹¹. Numerous studies from various parts of the World have shown that certain plant species effectively reduce the degree of parasite infestation in ruminants (sheep) and are promising alternatives to conventional anthelmintics¹²,¹³,¹⁴. Many of these plant species owe their anthelmintic effects to plant secondary metabolites such as saponins, tannins and essential oils¹⁵,¹⁶,¹⁷,¹⁸,¹⁹,²⁰. These effects are time and dose dependent.

Entada leptostachya and R. rhododendroides are among the plants used by the traditional healers in Mbeere and Embu Counties of Kenya as dewormers and are found in East Africa. Hence the aim of the present study was to determine the in-vitro potency of Entada leptostachya Harms and Rapanea rhododendroides (Gil) Mez. plant extracts against H. Contortus adult worms in infected sheep.

2. Materials and methods

2.1 Collection of indigenous knowledge: Over 30 herbalists from Mbeere County, Kenya were interviewed for their indigenous knowledge on common plants used to treat worm infestation in humans and ruminant animals. The plant ranking was based on the frequency of usage and preference. From this information two plants with
the highest ranking were selected for the present study. The root bark of *E. leptostachya* and stem bark of *R. rhododendroides* were collected after identification and authentication by a taxonomist of the Botany Department, Jomo Kenyatta University of Agriculture and Technology (JKUAT). Voucher specimens OOM/1 and OOM/2 were deposited in the herbarium of that department. The collected plant parts were dried under the shade and ground to a powder.

2.2 Plant extraction: The plant powders were subjected to hot water maceration to obtain aqueous extracts. Solvent extracts were carried out using methanol, acetone and hexane in a Soxhlet extractor. Extracts were dried under vacuum, placed in separate dry marked vials and stored at 4°C for further use.

2.3 Collection of *H. contortus* worms: Mature *H. contortus* worms were collected from the abomasums of freshly slaughtered sheep at a local abattoir, identified by a meat inspector and later confirmed by a parasitologist at Zoology department, JKUAT. The worms were washed in distilled water then suspended in phosphate buffered saline (PBS) made by dissolving 0.85 g of sodium chloride and 1 g glucose in 1 litre distilled water. They were then transported to the laboratory in an air tight can and then left for 2hrs to acclimatize.

2.4 Dissolution of plant extracts: Plant extracts were dissolved in DMSO and made to the mark using distilled water to make 25mg/ml solutions. Filter paper discs (6 mm diameter) were dipped into each solution. The discs impregnated with the above extracts were dried at room temperature to evaporate the DMSO, leaving only the test compounds. The discs for water extracts were not dried.

2.5 Screening of saponins and tannins in plant extracts: Saponins and tannins were screened using the methods described by Edeoga et al.20.

2.6 Determination of In-vitro anthelmintic activity: Ten (10) adult *H. contortus* worms were placed into a sterile Petri dish containing 10ml of PBS. The filter paper disc containing the aqueous extract was added and agitated. After 24 hours, the worms were removed from the Petri dish and the parasites suspended in PBS for 30min for possible recovery of the parasite motility. The number of motile (alive) and immotile (dead) worms were counted using a hand lens and recorded. Death or paralysis of worms was ascertained by absence of motility for an observation period of 5–6 seconds.21. The above procedure was repeated for all the other plants’ extracts. Three replicates were performed for each treatment. Albendazole (purchased from Kobian Ltd) at a concentration of 0.55 mg/ml was used as the reference drug (positive control) while PBS was used as a negative control. Worm motility and mortality were the rationale for anthelmintic activity.

3. Results and discussion
Table 1 shows the list of plants purported to treat worm infestation in ruminants as well as in humans. The ranking of 1-9 was on the basis of potency. There were claims, however, that plants with the highest ranking were used to treat stomach troubles in humans due to amoeba infections. There was unanimous agreement that *Entada leptostachya*, *Rapanea rhododendroides* and *Albizia anthelmintica* were used for deworming ruminant animals. The latter plants were reported to have anthelmintic activity.22.

| Local names | Scientific names | Ranking | Parts used |
|-------------|------------------|---------|------------|
| Mubarwa     | *Albizia anthelmintica* | 3       | Bark/roots |
| Mwinu       | *Senna didymobotrya* | 8       | Leaves     |
| Muvovo      | *Leonotis mollissima* | 5       | Leaves     |
| Mucaritha   | *Entada leptostachya* | 1       | Roots      |
| Mugeeta     | *Rapanea rhododendroides* | 2       | Bark       |
| Mururuku    | *Terminalia brownii* | 6       | Bark       |
| Terere      | *Amaranthus hybridus* | 9       | Leaves     |
| Mubera      | *Psidium guajava*   | 4       | Leaves     |
| Mubiru      | *Vangueria madagascariensis* | 7       | Leaves     |

*Plants commonly used to treat worms in ruminant animals*

Anthelmintic activity of the *E. leptostachya* and *R. Rhododendroides* extracts against *H. contortus* adult worms were presented in Table 2 and in Figure 1. The samples were tested at a concentration of 25 mg/ml and compared to Albendazole positive control, whose concentration was maintained at 0.55mg/ml as directed on the product label. All the plants’ extracts tested positive for saponins and tannins, except the hexane extracts.
Table 2. *In-vitro* anthelmintic activity of plants extracts

|                | Mean       | Mean std. error |                | Mean       | Mean std. error |
|----------------|------------|-----------------|----------------|------------|-----------------|
| **E. leptostachya** |            |                 | **R. rhododendroides** |            |                 |
| Acetone extract  | 27.78      | 3.74            | Acetone extract  | 25.83      | 3.17            |
| Aqueous extract  | 64.44      | 4.82            | Aqueous extract  | 46.94      | 3.92            |
| Hexane extract   | 20.56      | 3.03            | Hexane extract   | 13.06      | 2.32            |
| Methanol extract | 76.67      | 3.78            | Methanol extract | 54.44      | 3.60            |
| PBS              | 0.00       | 0.00            | PBS             | 0.00       | 0.00            |
| Albendazole      | 100.00     | 0.00            | Albendazole     | 100.00     | 0.00            |

*a* Three replicate determinations at a concentration of 0.25mg/l for each extract and 0.55mg/ml for Albendazole

*b* Standard mean error using SAS software

Figure 1. *In-vitro* anthelmintic activity of *E. leptostachya* and *R. Rhododendroides*

*E. leptostachya* and *R. rhododendroides* methanol extracts were more potent against *H. contortus* adult worms with mortalities of 77 and 54% respectively, when compared to other extracts. Hexane extracts were the least potent exhibiting mortalities of 21 and 13% for *E. leptostachya* and *R. rhododendroides* respectively. Aqueous extracts of both *E. leptostachya* and *R. rhododendroides* showed moderate potency against *H. contortus* adult worms. Acetone extracts were the second least potent, compared to other extracts. There were no significant differences (*p* = 0.17) in anthelmintic activity between acetone extracts of *E. leptostachya* and *R. rhododendroides*. However, aqueous, hexane and methanol extracts had significant differences (*p*<0.05). The reference drug albendazole showed 100% mortality at a concentration of 0.55mg/ml while the negative control PBS showed no mortality. The high mortality values exhibited by the methanol extracts of *E. leptostachya* root bark and *R. rhododendroides* stem bark support their medicinal uses in the treatment of GI nematodes. Secondary metabolites of plant origin have been found to have both *in-vivo* and *in-vitro* anthelmintic activity against GI nematodes in a dose and time dependent manner. The exact mechanism of saponins action against GI nematodes is not very well known. But Albendazole works by interference with the polymerization of microtubule23. The drug binds to the protein tubulin of the *H. contortus* hence causing death by starvation24. Tannins are reported to cause anthelmintic activity by binding to the proteins found in the gastro intestinal of the host or to glycoprotein on the cuticle of the parasite and may cause death25.

4. Conclusions
The traditional use of *E. leptostachya* and *R. Rhododendroides* by herbalists of Mbeere County, Kenya, has been established in the present study. These plants have potential in drug development for GI nematodes affecting ruminants.

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