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COMPARATIVE EFFICACY OF PYRETHRUM MARC WITH ALBENDAZOLE AGAINST SHEEP GASTROINTESTINAL NEMATODES

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ABSTRACT

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The efficacies of pyrethrum marc and of albendazole against experimental sheep gastrointestinal nematode infection were compared. Sheep were infected orally with 10 000 larvae (*Haemonchus* spp. (60.1%), *Oesophagostomum* spp. (13.9%), *Trichostrongylus* spp. (13.2%), *Cooperia* spp. (8.3%), *Nematodirus* spp. (3.5%), *Strongyloides* spp. (0.8%) and *Ostertagia* spp. (0.2%)). Faecal egg count reduction in albendazole-treated sheep was 100% by day 4 following treatment, compared to 37.03%, 31.3%, 38.9% and 51.8% on days 4, 6, 8 and 10 in pyrethrum marc-treated sheep. These reductions were statistically significant on days 8 and 10 post-treatment ($p < 0.05$). The potential for using pyrethrins for helminth treatment is discussed.

INTRODUCTION

Anthelmintic treatment is usually part of routine health care in intensive sheep enterprises because of considerable losses due to subclinical helminthoses (Soulsby, 1982). There are several anthelmintics with different modes of action available, the most commonly used in sheep being the broad spectrum groups especially benzimidazoles and imidazothiazoles (Roberson, 1988). Regular dosing is expensive, however, and is practised in only a small percentage of sheep farms in Kenya. In a recent study in Nakuru district, Mbaria *et al.* (1995) found that worm control programmes were based on rare and haphazard anthelmintic treatment in more than 90% of the farms investigated. Some farmers provided no treatment at all or used traditional herbal medicine.

Pyrethrum marc, the coarse flower materials which remain after extraction of pyrethrins from the dried flowers of *Chrysanthemum cinerariaefolium*, is cheap, available from the Pyrethrum Board of Kenya and contains 0.08% w/w pyrethrins. It is used for feeding ruminants and has the same nutritional value as green maize, bran or pollard. Pyrethrins are 6 esters viz, cenerin I, cinerin II, jasmolin I, jasmolin II, pyrethrin I and pyrethrin II (Barthel, 1973) and apart from their insecticidal actions, they are also reputed to possess anthelmintic properties. It was reported that in 1865 an enema containing pyrethrins evicted large numbers of *Enterobius vermicularis* from a

20-year-old man (McLellan, 1964). Chevalier (1930) reported successful therapy of children infected with *Ascaris*, *Taenia*, *Trichuris* and *Enterobius* using coated capsules containing 5 mg pyrethrins and designed to liberate their contents only on reaching the intestines. In a review of their anthelmintic properties, pyrethrins are said to be effective for helminthosis in both animals and man (McLellan, 1964). Mbaria (1990) found that pyrethrum extracts are lethal to both adult and immature stages of *Haemonchus contortus in vitro*.

Pyrethrins are considered to be very safe to mammals but very toxic to invertebrates and kill insects by severely disrupting their nerve function. Their mode of action against nematodes, however, has not been fully investigated. This paper reports a study to compare the efficacy of pyrethrum marc with albendazole against gastrointestinal nematode infections in sheep.

MATERIALS AND METHODS

Sheep

Twenty-two one-year-old dorper sheep of both sexes of approximately 21 kg were purchased from the University of Nairobi Veterinary Farm and West Laikipia Farm and transported to the University of Nairobi's College of Agriculture and Veterinary Sciences where the studies were conducted. They were housed in pens, fed good quality hay and wheat bran and clean tap water was available *ad libitum*. On arrival each animal was injected with long-acting oxytetracycline (Terramycin, Pfizer) as a prophylactic treatment against subclinical bacterial infection and dewormed using levamisole hydrochloride (Wormicide, Cosmos) at 7.5 mg/kg body weight. Four days following deworming, faecal egg counts (FECs) of each animal were performed using the modified McMaster technique (Coles *et al.*, 1992).

Experimental design

Twenty-two sheep were used in a cross-over design in 2 experiments. They were infected with nematodes and randomly divided into a control and an experimental group. Dry cultures were prepared from faeces collected from sheep flocks in Kinangop Division of Nyandarua district, Kenya. The samples were incubated for 9 days at 27°C and infective larvae were collected by suspension of the cultures in a water Baerman apparatus for 24 h. They were identified using larval morphology (Soulsby, 1982). The larvae isolated were *Haemonchus* spp., *Oesophagostomum* spp., *Trichostrongylus* spp., *Cooperia* spp., *Nematodirus* spp., *Strongyloides* spp. and *Ostertagia* spp. They were quantified by counting the number of live larvae per 0.05 ml and 10 000 larvae were administered orally by syringe to each sheep. The animals were monitored until all had patent FECs. A pooled faecal sample from all the 22 sheep was incubated as described above and infective larvae identified. The larvae recovered were *Haemonchus* spp. (60.1%), *Oesophagostomum* spp. (13.9%), *Trichostrongylus* spp. (13.2%), *Cooperia* spp. (8.3%), *Nematodirus* spp. (3.5%), *Strongyloides* spp. (0.8%) and *Ostertagia* spp. (0.2%).

Experiment I

The 22 sheep were randomly divided into 2 groups of 11 animals, an untreated control group and a treatment group. At day 0 each sheep in the treatment group was given a single oral dose of 0.2 ml/kg body weight of 2.5% albendazole (Valbazen, Ciba Geigy). Faecal eggs per gram (epg) and general health of all the animals were monitored on days 0 (day of treatment), 4, 6, 8 and 10.

Experiment II

The treated animals were re-infected 3 weeks later and monitored as described above until all the 22 animals were producing quantifiable faecal eggs. They were again randomly divided into 2 groups of 11 sheep each. One group was fed pyrethrum marc at the rate of 36 mg pyrethrins/kg body weight at days 0, 2, 4, 6, 8, and 10 while the other group was the untreated control. Faecal epg and overall health of all the animals were monitored on days 4, 6, 8, and 10.

Statistical data analysis and estimation of anthelmintic efficacy

Since the FECs were too dispersed for an ANOVA, the two-tailed Mann–Whitney test, a non-parametric procedure, was used for comparison of the epg means between the treated and control groups in the experiments (Zar, 1974). The anthelmintic efficacy was calculated from the FEC reduction (FECR) after treatment. The percentage FECR was corrected for the changes that occurred in the control group by the following equation:

$$(\text{FECR})\% = (1 - (T_2/T_1 \times C_1/C_2)) \times 100$$

where T and C are the geometric epg means for the treated and control groups and subscripts 1 and 2 designate the counts before and after treatment respectively (Campbell *et al.*, 1978).

RESULTS

The results of both experiments, summarized in Table I, indicate that animals treated with albendazole and those fed on pyrethrum marc had significantly lower FECs than the control groups. By day 4 the epg counts for every animal treated with albendazole had dropped significantly ($p < 0.05$) to below detectable levels compared to the control group. The group feeding on pyrethrum marc and the control had no significant differences in nematode egg counts at days 4 and 6 ($p > 0.05$), but there was a significant reduction in epg in the pyrethrum marc group in days 8 and 10 ($p < 0.05$).

TABLE I
Mean epg and percent FECR in pyrethrum marc- and albendazole-treated sheep (11 animals per group)

Time post-treatment (d)	Control EPG ± SE (range)	Albendazole EPG ± SE (range)	% FECR
Experiment I			
0	963 ± 220 (200 – 2600)	1100 ± 568 (100 – 6700)	
4	1000 ± 240 (100 – 3000)	0 ± 0.0	100[b]
6	1336 ± 335 (100 – 3300)	0 ± 0.0	100[b]
Experiment II			
0	682 ± 163 (100 – 1700)	1000 ± 158 (100 – 1800)	
4	1482 ± 669 (100 – 7800)	636 ± 219 (0 – 2500)	37.03[a]
6	1009 ± 272 (100 – 3100)	473 ± 139 (200 – 1600)	31.31[a]
8	1110 ± 203 (300 – 2100)	463 ± 128 (100 – 1200)	38.91[b]
10	791 ± 138 (200 – 1500)	260 ± 88 (0 – 800)	51.80[b]

[a] $p > 0.05$; [b] $p < 0.05$; % FECR, percentage faecal egg count reduction; epg, mean faecal egg count per gram

DISCUSSION

The dramatic drop in epg in the group treated with albendazole clearly indicates its anthelmintic effectiveness in sheep. There were also significant FECRs of 38.9% to 51.8% in days 8 and 10 of the group fed on pyrethrum marc which can only be attributed to the anthelmintic activity of pyrethrins in the pyrethrum marc. Thus for the sheep owners who cannot afford to treat their animals with modern anthelmintics, the use of pyrethrum marc in conjunction with good husbandry practices should be considered in the control of helminthosis. Albendazole had an efficacy of 100%, whereas pyrethrum marc had an efficacy of 31.3% to 51.8%, although the mean epg was still declining 10 days after treatment. Longer treatment might have more beneficial effects and more studies on the anthelmintic efficacy of pyrethrins are needed using either pyrethrum marc or other pyrethrin formulations.

Current control methods for internal parasites outside Africa focus on reducing contamination of pastures through anthelmintic treatment and/or controlled grazing. In Africa these methods are limited by high costs of anthelmintics, their uncertain availability, increased frequency of drug resistance and limited scope in many communal pastoral systems for controlled grazing. This calls for studies directed to develop alternative approaches to control internal parasites in Africa including the efficacy of traditional medicines which are easily accessible and could be cost effective. For example the cost of treatment with pyrethrum marc compared to albendazole was negligible. In addition, as well as being very cheap, pyrethrum marc has good

nutritional value. The results of these studies agree with earlier reports of the anthelmintic efficacy of pyrethrins.

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Effet comparatif du pyrethrum marc et de l'albendazole contre des infections gastrointestinales par nématodes chez le mouton

Resumé – L'efficacité du pyrethrum marc de l'albendazole a été comparée pour des infections gastro-intestinales par nématodes chez le mouton. Des moutons furent ovalement infectés avec 10 000 larves (60,1% de *Haemonchus* spp., 13,9% d'*Oesophagostomum* spp., 13,2% de *Trichostrongylus* spp., 8,3% de *Cooperia* spp., 3,5% de *Nematodirus* spp., 0,8% de *Strongyloides* spp. et 0,2% d'*Ostertagia* spp.). Le nombre d'oeufs dans les faèces furent réduits de 37,03%, 31,3%, 38,9% et 51,8% respectivement après 4, 6, 8 et 10 jours chez les moutons traités au pyrethrum. Ces réductions furent statistiquement significatives après 8 ou 10 jours de traitement ($p < 0{,}05$). Ce papier discute le potential des produits à base de pyrethrine pour le traitement des helminthiases.

Comparación de la eficacia de las piretrinas y el albendazole frente a los nematodos gastrointestinales del ganado ovino

Resumen – Se comparó la eficacia de pythrum marc y del albendazol frente a la infestación experimental de ganado ovino con nematodos gastrointestinales. Los animales fueron infestados oralmente con 10 000 larvas (*Haemonchus* spp. (60,1%), *Oesophagostomum* spp. (13,9%), *Trichostrongylus* spp. (13,2%), *Cooperia* spp. (8,3%), *Nematodirus* spp. (3,5%), *Strongyloides* spp. (0,8%) y *Ostertagia* spp. (0,2%)). En los animales tratados con albendazol, la reducción en el número de huevos en heces fue del 100% tras 4 días de tratamiento; en los animales tratados con piretrinas, la reducción fue del 37,03%, 31,3%, 38,9% y 51,8% tras 4, 6, 8 y 10 días de tratamiento respectivamente. Estas reducciones fueron estadísticamente significativas a los 8 y 10 días postratamiento ($p < 0,05$). Se discute la posibilidad de utilizar piretrinas en el tratamiento de las helmintiasis.