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Effect of repeated wattle tannin drenches on worm burdens, faecal egg counts and egg hatchability during naturally acquired nematode infections in sheep and goats

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ABSTRACT

In vivo and *in vitro* experiments were carried out to investigate the effect of repeated wattle tannin (WT) drenches on faecal egg counts (FEC), worm burdens and egg hatchability during a naturally acquired worm infection in sheep and goats. For the *in vivo* experiment, nematode-infected sheep and goats were orally drenched with WT at a dose of 1.3 g and 1.6 g WT/kg bodyweight per day for three consecutive days respectively while a control group received a placebo. FEC and other worm infection parameters were monitored regularly. Once a surge in faecal egg profiles was evident the drenching exercise was repeated as explained above. The trials were terminated by humane slaughter of all the animals and estimation of worm burdens recovered from their guts. WT drench did not, significantly, reduce FEC or total worm burdens in goats. However, there was a slight reduction in FEC and a significant reduction in *Haemonchus contortus* worm burdens in sheep. WT drenches were also associated with increased faecal water and mucus contents. The *in vitro* work involved the use of an egg hatch assay using faeces from WT-drenched and un-drenched goats. A dose-response experiment whereby goat faeces were spiked with different levels of WT and then cultured for larval count comparisons was also carried out. The presence of WT in culture media significantly ($P < 0.05$) reduced egg hatchability. There was a significant negative regression coefficient ($R^2 = 0.84$; $P < 0.01$) between concentration of WT in culture media and percent hatchability of nematode eggs. It is concluded that although the degree of anthelmintic activity of WT drench was limited, especially in goats, the drench was capable of reducing the hatchability of eggs passed out in faeces.

1. Introduction

Small ruminants make a significant contribution to food security and income of many resource-poor families in most developing countries. There are many constraints to small ruminant production including a range of diseases, poor nutrition, internal and external parasites. However, the main constraint to production of small ruminants in the tropics is gastrointestinal parasites, particularly nematodes (Perry et al., 2002). Parasitic infections lead to decreased productivity of affected animals which show poor growth rates, reduced reproductive performances, mortality, quality products and increased production costs (Waller, 1997; Perry and Randolph, 1999).

Until recently, the control of these parasites has been achieved mainly through the use of synthetic anthelmintics in combination with grazing management. However the emergence and spread of anthelmintic resistance among major nematode species is one of the major challenges facing control programs worldwide (Prichard, 1994; van Wyk et al., 2002). Apart from anthelmintic resistance, synthetic anthelmintics are expensive and have

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limited availability particularly to resource-poor farmers in many developing countries (Hammond et al., 1997). The search for new alternative methods for worm management, which are less reliant on the use of anthelmintics and more sustainable, has therefore been recognized (Hammond et al., 1997; Waller, 1997). The use of plants with anthelmintic properties has been considered a suitable worm control approach particularly for the resource-poor livestock keepers because the approach has potential for sustainability. Field studies in temperate regions indicated positive results when nematode parasitized sheep were fed on forages rich in tannins (Niezen et al., 1995). These findings were the impetus behind a number of studies investigating the effect of tannins on gastrointestinal nematode parasitism in small ruminants. Incubation of adult nematodes in cultures containing varying loads of tannins from different plant species showed significant reductions in the survival of various adult nematodes (Molan et al., 2000; Max et al., 2005a). Animal trials in which sheep and goats in the tropics were drenched with solutions of a commercial tannin preparation, wattle tannin (WT), gave significant reductions in both faecal egg counts (FEC) and worm burdens in sheep but only a slight effect in goats (Max et al., 2009). It was argued that although the effect of WT on FEC and worm burdens in goats was negligible, tannins could have effects on other important parasitological parameters such as female worm fecundity (Hoste et al., 2006) or reduction in hatchability of worm egg in faeces passed out after WT administration. Furthermore, it was argued by some readers that the batch of WT used in our work (Max et al., 2009) had been kept in the laboratory for quite some time and that could have reduced its activity against GI nematodes in their hosts.

The current study was therefore aimed at investigating the effect of WT drenches on not only FEC and worm burdens but also on faecal egg hatchability during a naturally acquired worm infection. Two batches of WT differing in shelf lives were used to find out whether the shelf life had any effects on tannins activity against the test nematodes.

2. Materials and methods

2.1. Study site and experimental animals

The study was carried out at Sokoine University of Agriculture in Morogoro, Tanzania, which is located around 6°48′S and 37°36′E at 500 m above sea level. Equal number of goats and sheep were used in two separate trials which were run concurrently. Thirty-nine Small East African (SEA) goats between 12 and 14 months and weighing 16.9 ± 2.8 kg were purchased from farmers on the outskirts of Morogoro town. Thirty-nine black head persian (BHP) × local rams averaging 15–20 months of age and averaging 21.5 ± 4.5 kg were sourced from a private commercial farm in the Coast Region. The two flocks were confined separately for a few days in four large deep-litter pens and received a single oral dose (20 mg/kg) of a broad spectrum anthelmintic (Valbazen® [Albendazole], Novartis East Africa Ltd., Kenya), to clear them of any nematode infestation before they were allowed to pastures. To protect the animals from coccidial infection which is endemic in the study area, a prophylactic dose of Trisulmix® (trimethoprim sulfadimethoxine, Coophavet Ltd., France) at 0.2 g/kg body weight was administered orally. Sheep and goats were fed on hay and supplemented with 120 g/day of maize bran-based concentrate (75% maize bran, 24% cotton seed cake and 1% minerals).

2.2. Wattle tannins

Wattle tannin powder was supplied by the courtesy of Tanzania Wattle Co. Ltd., Iringa. The powder is extracted from barks of tropical tree (*Acacia mearnsii*) and is a complex mixture of phenolic compounds in which the condensed tannins (CT) fraction predominates. Two different batches of the WT powder (old (OWT) and new (NWT), produced in the year 2000 and 2006, respectively) from the same supplier were used in order to find out whether shelf life has any effects as far as anthelmintic activity is concerned. According to the manufacturer, the WT powder, which is usually used in the leather industries, contains tannins, approximately 700 g CT/kg DM wattle tannin powder. The oral drenching solution was prepared by dissolving one part of the powder in two parts of lukewarm water.

2.3. Source of infection

The two flocks (sheep and goats) were allowed to acclimatize in the experimental environment and pick up a worm infection by allowing them to graze freely in larvae-infested pastures for 2 weeks. Random faecal samples were collected, cultured and the Baermann technique was used (Hansen and Perry, 1994) to isolate and identify the various larval genera contributing to the natural worm infection in the study area.

2.4. Experimental setup

After the acclimatization period, faecal egg counts (FEC) were monitored regularly using the modified McMaster method (Urquhart et al., 1987) and plotted against time. Following a significant rise in egg counts (500–1500 EPG fresh faeces), the animals were blocked on the basis of their faecal egg count numbers into low, moderate and high egg per gram (EPG) blocks. Equal numbers of animals from each block were then assigned randomly into three groups ($n = 13$). NWT, OWT and control groups received drenches of new tannin, old tannin and a placebo (i.e., water) respectively for three consecutive days. For both batches of tannins, sheep and goats were given a dose of 1.3 g and 1.6 g WT/kg body weight per day, respectively. The lower value for sheep than that offered to goats was due to findings from a previous study (Max et al., 2009), which had indicated that sheep were unable to tolerate a higher dosage. Monitoring of faecal egg counts and other parameters such as faecal material consistency continued after drenching. Faecal material was assessed using a scale of three scores; i.e., 1 = normal faeces (pellets); 2 = soft