

CAN FEEDING LOCALLY AVAILABLE PLANT MATERIAL RICH IN TANNINS REDUCE PARASITIC BURDEN IN RUMINANTS AND HENCE IMPROVE THEIR PRODUCTIVITY?

A. E. KIMAMBO¹, L.A. MTENGA¹, A.A. KASSUKU², P.J. BUTTERY³, D. WAKELIN⁴ and J. DAWSON.³

¹Sokoine University of Agriculture, Department of Animal Science and Production, P.O. Box 3004, Morogoro, Tanzania

²Sokoine University of Agriculture, Faculty of Veterinary Medicine, P.O. Box 3017, Morogoro, Tanzania.

³University of Nottingham, School of Biosciences, Sutton Bonington Campus Loughborough, Leicester, LE12 5RD, UK

⁴University of Nottingham, School of Life and Environmental Sciences, University Park, Nottingham, NG7 2RD, UK.

Abstract

Gastrointestinal parasitic infections are a major constraint to small ruminant productivity in the tropics and subtropics, including Tanzania. This significantly reduces the economy and food supply to small farmers and their families. Earlier studies at the University of Nottingham (see for example Butter *et al.*, 2000) have shown that feeding the extracted tannin from Quebracho (used in the leather industry) dramatically reduces the parasite burden of infected sheep. Tannins often occur in high concentrations in browse plants and could be used to control gastrointestinal parasites.

A three-year project (R7424) funded by the DFID Livestock Production Programme, was, therefore, initiated in 1999 between Sokoine University of Agriculture (Tanzania) and University of Nottingham (UK) to study the possibility of using locally available plant materials or their extracts to reduce parasitic burden in small ruminants. This approach has the potential to yield a cheap and environmentally friendly alternative to using chemically based anthelmintics. This paper briefly outlines the project aims and achievements to date.

Introduction

Small ruminants contribute significantly to meat and milk production in Africa. In Tanzania, it is estimated that small ruminants contribute 17.1% of total meat produced and consumed and thus they contribute a significant proportion of the animal protein consumed by the rural sector. However productivity from these animals is low due to many factors, including poor nutrition, disease and worm infestation. Helminth infections are the commonest and most significant endo-parasite constraint to small ruminant production in Tanzania (Kasuku and Tibaijuka, 1987). Intestinal parasites not only cause mortality of the livestock but also reduce their productivity and increase the proportion of carcasses condemned at the abattoirs. These losses have major impacts on economy of small farmers and their families. Parasitic infection could until recently be controlled by chemical anti-helminths but resistance is now common and these substances are expensive. Resistance of helminths worms to some anti-helmintic agents has been reported in some areas of Tanzania (Kasuku and Tibaijuka, 1987; Ngomuo *et al.*, 1990; Msangi *et al.*, 1990). Due to problems associated with the high costs of

anthelmintic drugs and the development of worms resistance to some of these drugs, much interest is now directed in developing nematode control methods that do not rely on anti-helmintic treatment. Such alternative methods include selective breeding for resistant hosts, grazing management and nutritional manipulation. Use of naturally occurring constituents in forages is yet another alternative to the expensive drugs. Tannins, which are naturally occurring secondary metabolites in plants, could reduce worm burden. Research at Nottingham has shown that dietary inclusion of the condensed tannin in quebracho extract reduces egg output and worm burden in sheep infected with *Trichostrongylus colubriformis* (Butter *et al.*, 2000). Similar results have been obtained by others (Athanasiadou *et al.*, 2000). This project is examining the potential of using naturally occurring constituents of forage to reduce the impact of the parasitic infections. The results will indicate the potential for promoting this husbandry practice to small farmers of this region. In addition the results will indicate the desirability of extending this practice to other areas of the world.

Project objectives

Gastrointestinal parasites are one of the major causes of production losses in goats. Their control would improve the livelihoods (wealth and food supply) of farmers, many of whom are women, and their families. Objectives of this project include:

1. To develop and promote strategies for the allocation and management of on-farm and locally available resources in order to optimise livestock production and improve their contribution to the crop/livestock farming system.
2. To determine if naturally occurring plants or plant extracts can be used to control gastrointestinal parasites in goats and other small ruminants.
3. To develop simple, cost effective and environmentally friendly methods of reducing the extent of gastrointestinal parasites in small ruminants.

Expected project outputs

1. Quantitative assessment, including seasonal variation, of the condensed tannin content of locally available plant material used as feed for small ruminants in the Morogoro region of Tanzania
2. Evaluation of the effectiveness of locally available tannin containing plant material or extracts in overcoming the production losses caused by gastrointestinal parasites in small ruminants
3. Training of a Tanzanian research student to Ph.D. level to continue the long-term objectives of improving the wealth and nutrition of local families
4. Results to be disseminated nationally and internationally at scientific conferences and in refereed journals. If appropriate follow-up on-farm trials will be initiated.

Planned Research Activities

1. Assessment of condensed tannin content of a range of locally available plant material in Tanzania.
2. Conduct *in vitro* and *in vivo* studies to evaluate the effectiveness of tannin-containing plant materials or plant extracts in reducing parasite burden in small ruminants.

Progress

1. Assessment of condensed tannin content of a range of locally available plant material in Tanzania

Plant materials (leaves and bark) were collected, from different shrubs and trees, forbes and leguminous plants, in January and April 2000 to represent the dry and wet seasons. Their tannin content was assessed using the acid butanol reaction for condensed tannin. It is accepted that this test only gives a relatively crude estimate of the tannin content. Those plants and plant parts found to have high tannin content were then selected and sampled at monthly interval for a period of one year and their tannin content determined. The reason for monthly sampling and determination of tannin content is to see whether tannin concentration was influenced by season. Results from the samples, already analysed, indicate that there is seasonal variation in tannin concentration in leaves and this will be presented in another paper (Mushi *et al.*, these proceedings). Since tannins are known to reduce the degradation of feedstuffs in the rumen, the effect on rumen degradability of some of the plant materials which were potentially to be used in the control of parasitic infections was assessed. The results are also be presented in another paper, (Mushi *et al.*, 2002).

2. *In vitro* and *in vivo* studies to evaluate the effectiveness of tannin-containing plant material or plant extracts in reducing parasite burden in small ruminants

The effect of plant extracts on nematode motility and viability

Discussions with local scientists in Tanzania have indicated that some indigenous plants, e.g. Aloe, have anti-parasitic properties. There is also evidence that some plants are used in traditional medicine to control gastrointestinal nematodes. It is planned to investigate the effectiveness of extracts from plant materials found to have a high tannin content on parasites *in vitro*.

2.1 *In vitro* studies to evaluate the effectiveness of tannin extracts to Kill *Haemonchus*

Due to problems of routinely obtaining *Haemonchus contortus* worms, which involves sacrificing an animal, the mouse parasite, *Heligmosomoides polygyrus*, was used. Initial studies investigated the effect of quebracho tannin extract. In Tanzania, a tannin containing extract obtained from wattle/mimosa (*Acacia mearnsii*) is used in the local leather industry. Both tannin extracts readily killed the cultured parasites. The mimosa extract was found to be the more potent.

2.2 *In vivo* feeding trials to determine the dose response efficacy of quebracho tannin against *Trichostrongylus colubriformis* and *Haemonchus contortus*

Previous work carried out at the University of Nottingham with quebracho tannin has consistently used concentrations of 40-50 g/kg to represent the levels typically found in plant material. However, lower concentrations of tannin may be equally effective. Two feeding trials using tannin incorporated in the feed at concentrations of 0, 2, 4, 5 and 8 % w/w of feed intake in experiment 1 and 0, 2.5, 5, and 8 % w/w of feed intake in experiment 2 were conducted using sheep artificially infected with *Haemonchus contortus*. Further studies, in which animals were drenched with quebracho tannin at 0 and 8 % w/w of feed intake were also conducted. The drenching method was found to be more effective in reducing faecal egg count and worm burden than the method of mixing in the feed. Thus the work, which will be done in Tanzania, will evaluate drenching with tannin extracts as well as feeding plant materials with a high tannin content. The goat will be used as the experimental animal reflecting the importance of the goat in this region.

3. Training

This is a major project component of the project.

3.1 One of the research team attended a three-week training course at the University of Nottingham, in November 1999, on methods for analysing condensed tannin in plant materials.

3.2 Training of a Tanzanian research student to Ph.D. level at the University of Nottingham and Sokoine University of Agriculture.

3.3 Dissemination of results in National and International Scientific conferences and in refereed journals. These are reported in the two subsequent papers in this volume. Two further publications are in preparation.

References

ATHANANASIADU, S., KYRIAZAKIS, I., JACKSON, F. and COOP, R.L. (2000). Consequences of long-term feeding with condensed tannins on sheep parasitised with *Trichostrongylus colubriformis*. *International Journal of Parasitology*, **30**: 1025-1033.

BUTTER, N.L., DAWSON, J.M., WAKELIN, D. and BUTTERY, P.J. (2000). Effects of dietary tannin and protein concentration on nematode infection (*Trichostrongylus colubriformis*). *Journal of Agricultural Science, Cambridge*, **134**: 89-99.

KASUKU, A. A. and TIBAIJUKA, B. (1987). Anthelmintic resistance of a *Haemonchus contortus* strain in sheep and goats at Sokoine University of Agriculture. *Proceeding of the 5th Tanzanian Veterinary Association Scientific Conference 1 - 3 Dec. 1987 at Arusha, Tanzania*.

MSANGI, S. J. A., NGOMUO, A. J. and KASUKU, A. A. (1990). The efficacy of oxtendazote against a strain of *Haemonchus contortus* resistant to Fenbendazote and thiophanate. *Tanzania Veterinary Bulletin*, **10**: 1- 7.

NGOMUO, A. J., KASUKU, A. A. AND RUHETA, M. R. (1990). Critical controlled test to evaluate resistance of field strains of *haemonchus contortus* to Thiophonate. *Veterinary Parasitology*, **36**: 21 - 26.