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Use of plants in novel approaches for control of gastrointestinal helminths in livestock with emphasis on small ruminants

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Abstract

Helminth infections are a major cause for reduced productivity in livestock, particularly those owned by the poor worldwide. Phytomedicine has been used for eons by farmers and traditional healers to treat parasitism and improve performance of livestock, and many modern commercial medicines are derived from plants. However, scientific evidence on the anti-parasitic efficacy of most plant products is limited, regardless of their wide ethnoveterinary usage. Scientific validation of the anti-parasitic effects and possible side-effects of plant products in ruminants is necessary prior to their adoption as a novel method for parasite control.

A variety of methods has been explored to validate the anthelmintic properties of such plant remedies, both in vivo and in vitro. In vitro assays are useful as pre-screens of activity and are mainly performed with the free-living rather than parasitic stages of nematodes. Concentrations of potentially active substances used in vitro do not always correspond to in vivo bioavailability. Therefore, in vitro assays should always be accompanied by in vivo studies when used to validate the anthelmintic properties of plant remedies.

In vivo controlled studies have shown that plant remedies have in most instances resulted in reductions in the level of parasitism much lower than those observed with anthelmintic drugs. Whether it is necessary or not to achieve very high efficacy in order for plant remedies to have a role in the control of parasitism depends on the determination of biologically important levels of reduction of parasitism and it will be required prior to the wide-scale use of plant products for parasite control. Similarly, standardisation of validation studies in reference to the numbers of animals required for in vivo studies to measure direct anthelmintic effects of a plant needs to be established.

Although in many cases the active compounds in the herbal remedies have not been fully identified, plant enzymes, such as cysteine proteinases, or secondary metabolites, such as alkaloids, glycosides and tannins have shown dose-dependent anti-parasitic properties. However, as some of the active compounds may also have anti-nutritional effects, such as reduced food intake and performance, it is essential to validate the anti-parasitic effects of plant products in relation to their potential anti-nutritional and other side effects. A concerted effort on isolation, development, and validation of the effects of these herbal remedies will have to be undertaken before their wider acceptance.

Keywords: Phytomedicine; Ethnoveterinary medicine; Condensed tannins; Bioactive forages; Small ruminants; Parasite control

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1. Introduction

In many developing countries around the world, farmers, herders, pastoralists and occasionally veterinary surgeons use plant or plant products to treat cases of parasitism. The related available evidence mainly concerns gastrointestinal helminths, but there is also evidence for effects on blood parasites and external parasites. In traditional societies there seems to be a number of plant remedies deemed suitable for each parasitic disease. For example, seeds or the foliage of plants such as garlic, onion, mint, walnuts, dill, or parsley have been used to treat animals that suffer from gastrointestinal parasitism, while cucumber and pumpkin seeds have been associated with the expulsion of tapeworms from the gastrointestinal tract (Guarrera, 1999). The administration of extracts from *Acacia* and *Artemisia* spp. in animals infected with blood parasites, such as *Trypanosoma* and *Plasmodium* spp., has resulted in a reduction in the number of blood parasites, whereas tobacco leaves have been used to control ectoparasites (Adewunmi et al., 2001; Deharo et al., 2001; Lans et al., 2000). Although many of the plants or plant extracts have been reported for their general antiparasitic properties, in this review we will focus on those with specific anthelmintic properties.

Evidence of the anthelmintic properties of plants and plant extracts is derived primarily from ethnoveterinary sources. The use of ethnoveterinary plant preparations has been documented in different parts of the world (Anon., 1994, 1996; Bizimana, 1994; Waller et al., 2001; Wanyama, 1997a,b; Watt and Breyer-Brandwijk, 1962). A number of plants with denoted anthelmintic properties have also been included in the British pharmacopoeia (British Veterinary Codex, 1953, 1965). For example, oil of chenopodium that derives from *Chenopodium ambrosioides*, was used for many years in the UK to treat nematode parasite infections (*Strongylus, Parascaris* and *Ascaris* spp.) in monogastric animals including humans (Gibson, 1965). Also leaves and dried flowers, have been used as an anthelmintic since the early 1900s (Guarrera, 1999). *Chenopodium* is still used to treat worm infections in Latin America. In addition, male fern *Dryopteris filix-mas* and *Artemisia* spp. plants have been used against cestodes such as *Moniezia* spp., and nematodes, such as *Ascaridia* spp., in ruminants and poultry respectively (British Veterinary Codex, 1965).

Recent surveys in developing countries have identified many plants that are intended and have the potential to be used as anthelmintics. Table 1 lists a representative sample of these surveys. However, the

Table 1
Ethnoveterinary sources on plants identified with potential anthelmintic activity

Origin of survey	No of plants with anthelmintic activity	Anthelmintic activity	Hosts	Reference
SE Asia	23	Roundworms, cestodes, trematodes	Monogastrics, Ruminants	Anon. (1994)
Kenya	19	Roundworms cestodes trematodes	Monogastrics, Ruminants	Anon. (1996)
Eastern and Southern Africa	>100	Hookworms, cestodes, roundworms, trematodes	Humans, Ruminants	Watt and Breyer-Brandwijk (1962)
East Africa	>100	Hookworms, roundworms, cestodes	Humans, Ruminants	Kokwaro (1993)
West Africa	18	Roundworms, cestodes	Monogastric	Ibrahim et al. (1984)
Zaire	11	Roundworms	Ruminants	Kasonia et al. (1991)
Nigeria	15	Roundworms, trematodes	Ruminants, Monogastric	Nwude and Ibrahim (1980)
Africa	>50	Roundworms, trematodes cestodes	Ruminants, Monogastric	Bizimana (1994)
Worldwide	100	Cestodes, trematodes, nematodes	Humans	Tagboto and Townson (2001)
Indian subcontinent	6	Helminths	Monogastric	Nadkarni (1954)
Indo-Pakistan subcontinent	>50	Hookworms, roundworms, cestodes	Ruminants, Monogastric	Akhtar et al. (2000)