ABSTRACT

Helminthosis is one of the major problems of livestock production throughout the world, particularly in tropical and sub-tropical areas. Chemical control of helminthes is in practice in most of the parts of the world. In some regions, however, traditional treatment/control is achieved by using ethno-veterinary medicine. A number of chemicals had been effectively controlling/eliminating the worms, but increasing prevalence of anthelmintic resistance in nematodes in domestic ruminants (Waller, 1994), combined with rising consumer concerns about chemical use on farms, has encouraged research into alternative strategies for the control of internal parasites in New Zealand (Niezen et al., 1993). Therefore, researchers are focusing researches on the alternatives to the chemical control of helminthes. Tannins containing plants have been reported to controlling/eliminating the worms, but increasing prevalence of anthelmintic resistance in nematodes in domestic ruminants (Waller, 1994), combined with rising consumer concerns about chemical use on farms, has encouraged research into alternative strategies for the control of internal parasites in New Zealand (Niezen et al., 1993). Therefore, researchers are focusing researches on the alternatives to the chemical control of helminthes. Tannins containing plants have been reported to reduce worm burden and increase animal performance. This paper reviews some studies on the anthelmintic effects of tannins.

Key Words: Anti parasitic; Antimicrobial; Tannins

Feeding forage legumes containing condensed tannins, such as sulla (Hedydarum coronarium) and lotus major (Lotus pedunculatus) significantly increased growth of parasitized lambs (Niezen et al., 1995, 1998; Robertson et al., 1995), deer (Hoskin, 1998) relative to feeding legumes containing only trace levels of condensed tannins, such as Lucerne. Fresh sulla (Condensed tannins 55 g/kg DM) decreases the degradation of forage protein and ‘S’ amino acids to inorganic sulphide in the rumen and increase absorption of Methionine and Cystine in sheep (McNabb et al., 1993). Grazing sulla also reduced gastrointestinal worm numbers in sheep relative to sheep grazing Lucerne (Neizen et al., 1998). Hoskin (1998) found a linear negative relationship between the concentration of condensed tannins in forage legumes fed to deer and the apparent establishment of abomasal nematodes. In the same study, lower counts of faecal lungworm L1 larvae were reported in the deer fed sulla, containing 3-5% tannins, than in deer fed Lucerne, with only 0.1% tannins.

Feeding diets containing rumen by-pass protein to parasite-infected sheep and goats reduced production losses attributed to parasitism (Blackburn et al., 1991, Donaldson et al., 1997), and enhanced immunity (Coo et al., 1995; Van Houtert et al., 1995). Bown et al. (1991a) showed that an infusion of protein into abomasums of lambs trickle – infected with Trichostrongylus colubriformis resulted in reduced worm numbers and improved lamb performance. It has been suggested that the increased by-pass protein supply caused by the action of condensed tannins present in the forage legumes helps counteract the protein losses caused by GI nematode infections (Poppi et al., 1986, 1990; MacRae 1993; Sykes, 1994). However, no grazing or indoor feeding studies with by-pass protein supplements or forages containing condensed tannins have been carried out with parasitized deer.

In vitro research has demonstrated that condensed tannins extracted from forage legumes has direct inhibitory activity against L1 and L3-stage deer-origin lungworm larva and L3- deer- and sheep-origin gastrointestinal nematode larvae, as measured using a larval migration inhibition assay (Molan et al., 2000a,b). However, despite potential direct effects of condensed tannins on sheep and deer parasites and indirect nutritional benefits of condensed tannins for parasitized ruminants, no research has been conducted into the effects of feeding forages containing condensed tannins on any aspect of internal parasitism in deer.

The negative relationships between dietary condensed tannins concentration and abomasal nematode numbers suggest that the concentration of condensed tannins may be responsible, but the possibility remains that the structure (or plant origin) of condensed tannins may also exert an effect (Foo et al., 1996).

Condensed tannins affect abomasal nematode numbers. Condensed tannins react and form complexes with protein in a pH-dependent manner (Jones & Mangan, 1977) and binding can be highly specific for different tannins as well as different proteins (Asquith & Butler, 1986). Condensed tannins found in forage legumes fed to deer could, therefore, interact with protein secretions excreted by nematodes in the gut (McKellar et al., 1985), or excreted by gut microorganisms in response to the presence of parasites (Lawton, 1995).

Molan et al. (2000b) used an in vitro assay to show that condensed tannins extracted from sulla and birdsfoot trefoil inactivated deer L1 lungworm larvae by 42 and 35%, respectively. Condensed tannins extracted from sulla were also found to be more effective than condensed tannins from birdsfoot trefoil at paralyzing sheep Trichostrongylus colubriformis larvae (Molan et al., 2000a). Neizen et al. (1998) reported a reduction in GI nematodes, particularly...
intestinal *Trichostrongylus* spp., in lambs grazing sulla, compared with no reduction for lambs grazing other condensed tannins-containing forage legumes also suggesting that the structure of condensed tannins affect efficacy. Faecal egg count and worm burden were reduced in sheep infected with *L*._1* of *H. contortus, T. colubriformis* and *N. battus* given Quebracho (CT) at 3.5% w/w of food intake x 3 (Athanasiadou et al., 2000). Condensed tannin (Quebracho) in the culture decreases the viability of *L*._3* in *H. contortus, Ostertagia* and *Trichostrongylus* (Athanasiadou et al., 2001).

Hoskin (1998) observed that significantly fewer *Ostertagia*-type and *Trichostrongylus axei* nematodes became established in red deer fed sulla than in deer fed *L. corniculatus*. *L. corniculatus* (CT 27 g/kg DM) reduce rumen protein degradation and increases utilization of plasma cystine (Wang et al., 1994).

Condensed tannins have been shown to inhibit endogenous enzyme activities (Oh and Hoff 1986, Horigome et al., 1988) and condensed tannins isolated from 18 plant species including *L. pedunculatus* and *L. corniculatus* were potent inhibitors of the cyclic AMP-dependent protein kinase in rat liver (Wang et al., 1996). *L. pedunculatus* feeding in animals can increase post ruminal flow of ‘N’ and ‘EAA’ (Barry & Manley, 1984).

Because of their reactivity with plant proteins as they are being chewed by ruminant animals, condensed tannins partially protect animals against rumen degradation, and so increase the flow of amino acids to the small intestine and increase their absorption from the small intestine of sheep (Waghorn et al., 1987, 1987a, 1994). This increase may help to counteract the losses of protein attributed to gastrointestinal nematode infection (Poppi et al., 1990; MacRae, 1993; Sykes 1994). Feeding forages containing condensed tannins, such as sulla and *L. pedunculatus*, significantly increased the growth rate of parasitized lambs (Niezen et al., 1995; Robertson et al., 1995) compared with that of lambs fed legumes not containing tannins, and the rate of establishment of the parasites was lower in lambs grazing sulla (Robertson et al., 1995).

The condensed tannins extracted from the four forages differed greatly in their activity against the larvae of lungworm and gastrointestinal nematodes of deer, with the order from highest to lowest consistently being sainfoin, *L. pedunculatus*, sulla and *L. corniculatus*. The differences in activity may be attributed to differences in the molecular weight and structure of the different tannins (Jones et al., 1976; Asquith & Butler, 1986; Foo et al., 1996, 1997). The average molecular weight of the tannins from *L. pedunculatus* is 2200, slightly higher than that of the tannins from *L. corniculatus*, that has molecular weight 1990 (Foo et al., 1996, 1997). Furthermore, the tannins from *L. pedunculatus* contain a predominance of prodelphinidin-type subunits (Foo et al., 1997); whereas, the tannins from *L. corniculatus* have predominantly procyanidin-type subunits (Foo et al., 1996). Condensed tannins with a high molecular weight interact more strongly with enzyme and other proteins than those with a low molecular weight (Beart et al., 1985; Horigome et al., 1998; Kawamoto et al., 1996), and their reactivity increases with increasing prodelphinidin content (Jones et al., 1976).

**CONCLUSIONS**

Based on review, it is concluded that condensed tannins may be tried as potential candidate for the control of helminthes in livestock. Therefore, controlled studies to evaluate the anthelmintic activity of tannins be carried out.

**REFERENCES**


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