Effects of administration of industrial tannins on nutrient excretion parameters during naturally acquired mixed nematode infections in Moghani sheep

Majid ChaichiSemsari[1]*, Naser MaheriSis[1], Mohammad Sadaghian[2], Behrad Eshratkhah[2], Shahin Hassanpour[1]

[1.] Dept. of Animal Sciences, Shabestar Branch, Islamic Azad University, Shabestar, Iran
[2.] Dept. of Veterinary Medicine, Shabestar Branch, Islamic Azad University, Shabestar, Iran

Majid.chaichi@gamil.com

Abstract: Tannins are one of the secondary metabolites of plants that tend to combine with protein and reduce parasitic properties in livestock and veterinary industry. The aim of this study was to investigate effects of different levels of Quebracho Condensed Tannins (QCT) on Crude protein (CP) and other excretion parameters during naturally acquired mixed nematode infections in Moghani sheep. Twenty ewes (6-12 months years-old) with average body weight (26.5 ± 3.5 kg) were selected randomly and divided into four experimental groups: Control, A, B and C (were given 0, 1.5, 2 and 2.5 g/kg body weight QCT, respectively) in summer 2010. In order to reduce the undesirable effects of tannins, it was used as a single oral dose drenches. Faecal samples were taken at 24 and 48 hour after treatment. Our result showed that protein excretion has a significant difference in all treatment groups compare to control group after 24 hours from drenching ($P<0.05$). Also, 48 hours after drenching, CP excretion was significantly decreased in treatment groups ($P<0.05$) and the QCT has no significant effect on faecal excretion of dry matter (DM), organic matter (OM) and ash ($P>0.05$). Our results indicate that high levels of tannins intake were decreased protein excretion and increased retention of nitrogen in animal body.

[Majid ChaichiSemsari, Naser MaheriSis, Mohammad Sadaghian, Behrad Eshratkhah, Shahin Hassanpour. Effects of administration of industrial tannins on nutrient excretion parameters during naturally acquired mixed nematode infections in Moghani sheep. Journal of American Science 2011;7(6):245-248]. (ISSN: 1545-1003). http://www.americanscience.org.

Keywords: Quebracho tannin, protein excretion, nematode, sheep

1. Introduction

Plant secondary metabolites are a diverse group of molecules that have not especial role in major plant processes such as Photosynthesis and Respiration. One of the most important secondary compounds can be pointed to the tannins (Karma et al., 2008). Mainly tannins were in all trees, shrubs and leguminous plants (Perevolotsky, 1994) and any altering in soil quality and weather conditions can change the levels of tannin in plant (Van Soest, 1994). Tanin has a very complex chemical structure (polyphenolic substances with various molecular weights and variable complexity) so it define is difficult (Schofield et al., 2001). Tannins are divided into two groups condensed (CT) and the hydrolysable tannins (HT) (Mueller-Harvey, 1999). The most important properties of tannins are mixture with proteins and ions but most tannin tend to combine with relatively large, hydrophobic and rich praline proteins (Hagerman et al., 1992).

Few decades ago, believed the anti nutrition effects of tannins are mixture with dietary protein which causes to reduce feed intake, diet digestibility and rumen fermentation (Barry and McNabb, 1999; Kumar and Singh, 1984; Mueller-Harvey and McAllan, 1992). Also, concluded that the tannins of different plant species have different chemical and physical properties (Hagerman and Butler, 1991). Therefore, previous researchers demonstrated that ruminants fed by tanniniferous plants cause to benefits such as greater availability of (mainly essential) amino acids for absorption in the small intestine, nitrogen retention, reduce bloating, increase milk production, live weight, wool production and rates of ovulation (Min et al., 2003, 1999; Kriaa and Thewis. 1998/1999; Wang et al., 1996, 1994; McMahon et al., 2000).

On the other hand, gastrointestinal nematodes (GIN) are major problems in the livestock industry which considered decreasing of prolificacy, reducing reproductive performance, poor growth rate, low milk and wool production in ruminants (Max et al., 2005). Additionally, previous researchers reported grazing sheep and goats with tanniniferous hay cause to decrease load of nematode infection. Thus, they believe tannins have anthelmintic effects (Max et al., 2005; Maherisis et al., 2001). It seems CTs are capable formation complex with nematodes cuticle and may be due toxic effects on them (Niezen et al., 1995). The main propose of this study was to investigate short term effects of different levels of QCT as a anthelmintic on CP, OM, DM and Ash

excretion during naturally acquired mixed nematode infections in Moghani sheep.

2. Material and Methods

This study was carried out at Moghan plateau in Ardebil province, Northwest of Iran, which is located around 30°24′35.47″N and 48°18′12.36″E at 98m above sea level. In the first step, faecal samples was taken from the rectum of 200 grazer sheep in plastic containers and sent to lab by cold-temperature process (4°C). The parasite infection was determined in fecal samples. In laboratory, faecal egg counts (FEC) was monitored regularly using the modified McMaster technique (MAFF, 1978). In the second step, Twenty ewes (6–12 months' years old) with averaging body weight (26.5 ± 3.5 kg) with moderate load of GIN infection (the mean of FECs was about 450 per gram) were selected. Animals randomly were divided into 4 treatment groups (n = 20). All animals were given 7 hours fasting period then Control group received tap water as a placebo whereas A, B and C groups drenched (1.5, 2, 2.5 g/kg body weight) QCT as a water suspension, respectively for one day. The CT is astringent, so QCT suspended in 300 cc tap water. During the study, all animals fed *ad libitum* in Moghan plateau and free access to water. Faecal samples were taken 24 and 48 hours after drenching QCT. CP, DM, OM and Ash were determined using standard procedure (AOAC 1990). Data were processed in excel and analyzed as a complete randomized design for repeated measurements using SAS Software (version. / 9.1) and the least square means compared with Tukey multiple range tests.

3. Results

The mean ± SE of the studied parameters was shown in Table 1. Also, the mean variation of CP excretion in different groups during the experiment was shown in Figure 1.

Our results indicate that there was a significant difference in CP excretion at 24 hours after administration of tannin to treatments compare to the control group (*P<0.05*); however, there was no significant difference between B and C groups and maximum CP excretion was observed in C group. Also, there was a significantly difference in CP excretion at 48 hours after administration of the QCT only between C and other groups (*P<0.05*).

Additionally, there was no significance differences between groups in DM, OM and Ash levels (*P>0.05*).

4. Discussions

Tannins are mainly effective on reducing the nutrition ration digestibility but their influence on the proteins to form hydrogen bond that dependent to pH (3.5 to 8). This combination is strong at pH rumen. It separates easily when the pH is lower than 3.5 or higher than 8 (Hagerman et al., 1992). Most possible mechanisms to reducing food digestibility in rumen by tannins were accepted by previous researchers which tannins due to this manner by substrate, enzyme and microorganisms inhibition (McMahon et al., 2000; Jones et al., 1994; Scalbert, 1991). McAllister *et al*. (1994) had reported to prevent tannins from binding microorganisms to plant cell walls which is necessary for them digestibility. Also, some researchers believe that the tannins have the ability to change the activity of Fibrolytic and Proteolytic enzymes (O'Donovan and Brooker, 2001; Waghorn, 1996). However, some authors observed that tannins may have directly affected by increase the membrane permeability of microorganisms (Scalbert, 1991; Leinmüller et al., 1991).

Table 1- Effect of different levels of Quebracho tannin on CP, DM, OM and Ash execration in nematode infected ewes

Factors	Groups	Time (hour)	
		24	48
CP% Mean ± SE	Control	13.57±0.21^{c}	13.33±0.2^{cd}
	A	14.2±0.19^{b}	13.16±0.18^{cd}
	B	15.34±0.17^{a}	12.92±0.15^{d}
	C	15.4±0.19^{a}	11.37±0.2^{e}
DM% Mean ± SE	Control	33.44±0.25	33.4±0.51
	A	33.75±0.19	33.88±0.44
	B	34.67±0.22	33.82±0.45
	C	34.09±0.21	33.81±0.49
OM% Mean ± SE	Control	77.02±1.47	76.79±0.68
	A	76.64±1.3	77.21±0.55
	B	76.03±1.31	77.56±0.63
	C	77.8±1.45	77.28±0.61
Ash% Mean ± SE	Control	22.79±0.74	23.24±0.69
	A	23.02±0.56	22.47±0.59
	B	22.53±0.61	21.76±06
	C	22.2±0.64	22.78±0.65

A: 1.5g QCT/kg body weight; B: 2g QCT/kg body weight; C: 2.5g QCT/kg body weight; CP: Crude protein; DM: Dry matter; OM: Organic matter; there is a significant difference among groups with different letters (a, b, c, d, e) in protein and other excretion factors values *(P < 0.05)*; SE: Standard error.

One of the most obvious evidence demonstrates that tannins due to reduce protein digestibility by increased nitrogen excretion and increasing amounts of tannin nutrition ration (Silanikove et al., 1994). Excreted protein has 2 sources: Endogenous and exogenous; tannins have to be inclined with both of the protein so it's difficult to determining site of excreted protein (Waghorn, 1996). Research showed that feeding sheep with the tannin silage Mimosa was

added, protein excretion greater than the sheep fed with hay addition to the chestnut tannin (Deaville et al., 2010). Bengaly et al,. (2007) showed that Wattle tannins in food goats (3 g/kg Dry matter of ration) increase the protein excretion. Also, previous researches were reported drenching different levels of Wattle tannin decreased faecal protein excretion in nematode infected Moghani ewes (Hassanpour et al., 2011). However, Kriaa and Thewis (1998, 1999) reported that sheep fed with little amounts of chestnut (0.8 g/kg Dry matter of ration) were decreased protein excretion and increased retention of nitrogen in animal body. Results of this experiment were different with previous researchers (Scalbert, 1991; Deaville et al., 2010; Bengaly et al,. 2007). According to our previous results (Maherisis et. al., 2011) We believe increasing high levels of QCT cause to decreasing nematode FEC and increase tannin-protein complex and decrease protein degradability in the rumen; thus, increasing NPN and amino acid flow to the small intestine and increased dietary protein absorption. Finally, decreased excretion of protein and increased nitrogen retention in the body.

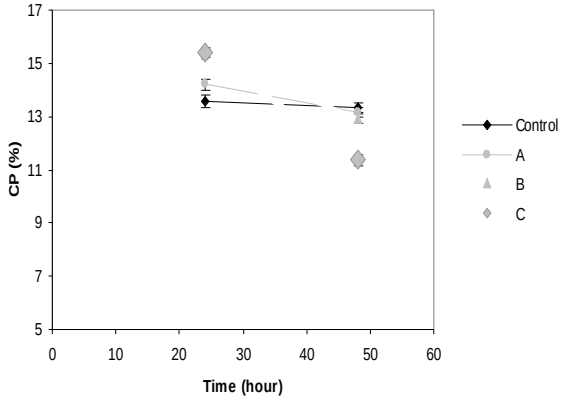

Figure 1- comparison of mean variations of CP excretion in different groups during the experiment period.

Acknowledgements:

Authors are grateful to the Department of Animal Science and Veterinary medicine of Islamic Azad University, Shabestar branch

Corresponding Author:
Majid Chaichisemsari.
Department of Animal Science, Shabestar Branch, Islamic Azad University, Shabestar, Iran.
Tell: +98 914 3158028
E-mail: majid.chaichi@gmail.com

References

1. Association of Official Analytical Chemists (AOAC). Official Method of Analysis .15th . edition Washington DC .USA 1990; 66-88.
2. Barry TN, McNabb WC. The implications of condensed tannins on the nutritive value of temperate forages fed to ruminants. Brit J Nutr 1999; 81: 263-272.
3. Bengaly K, Mhlongo S, Nsahlai IV. The effect of wattle tannin on intake, digestibility, nitrogen retention and growth performance of goats in South Africa. Livestock Res. Rural Develop2007; 19: (4).
4. Deaville ER, Givens DI, Mueller-Harvey I. Chestnut and mimosa tannin silages: Effects in sheep differ for apparent digestibility, nitrogen utilisation and losses. Anim. Feed Sci. Technol 2010; 157: 129-138.
5. Hagerman AE, Butler LG. Tannins and lignins. In: Herbivores: their interactions with secondary plant metabolites, Vol I: The chemical participants, (Rosenthal G.A. and Berenbaum M.R., eds.), Academic Press, NY (USA) 1991; 355-388.
6. Hagerman AE, Robbins CT, Weerasuriya Y, Wilson TC, McArthur C. Tannin chemistry in relation to digestion. J. Range Manage 1992; 45: 57-62.
7. Hassanpour S, Sadaghian M, MaheriSis N, Eshratkhah B, Chaichisemsari M. Effect of condensed tannin on controlling faecal protein excretion in nematode-infected sheep: in vivo study. Journal of American Science 2011; 7(5) 896-900.
8. Jones GA, McAllister TA, Muir AD, Cheng KJ. Effects of sainfoin (Onobrychis viciifolia Scop.) condensed tannins on growth and proteolysis by four strains of ruminal bacteria. Appl Environ Microb 60 1994; 1374-1378.
9. Karma DN, Patra AK, Chatterjee PN, Kumar R, Agarwal N. Effect of plant extract on methanogenesis and microbial profile of the rumen of buffalo: a brief overview. Aust G Exp Agric 2008; 48: 175-178.
10. Kriaa S, Thewis A.. The influence of the addition of extract of chestnut tannin on the nitrogen balance and the digestibility of fresh grass in ruminants. Tropicultura 1998/1999; 16-17: 26-28.
11. Kumar R, Singh M. Tannins: their adverse role in ruminant nutrition. J Agr Food Chem 1984; 32: 447-453.
12. Leinmüller E, Steingass H, Menke KH. Tannins in ruminant feedstuffs. Biannual Collection of Recent German Contributions Concerning Development through Animal Research1991; 33: 9-62.

13. Maff. Manual of Veterinary Parasitological Techniques. Technical Bulletin No. 18. Ministry of Agriculture, Fisheries and Food, London 1978.
14. Maheri Sis N, Chaichi Semsari M, Eshratkhah B, Sadaghian M, Gorbani A, Hassanpour S. Evaluation of the effects of Quebracho condensed tannin on faecal egg counts during naturally acquired mixed nematode infections in Moghani sheep. Annals of Biological Research2011; (2): 170-174.
15. Max RA, Wakelin D, Dawson JM, Kimambo AE, Kassuku AA, Mtenga LA, Craigon J, Buttery PJ. Effect of quebracho tannin on faecal egg counts and worm burdens of temperate sheep with challenge nematode infections. Journal of Agricultural Science 2005; 143: 519 – 527.
16. McAllister TA, Bae HD, Jones GA, Cheng KJ. Microbial attachment and feed digestion in the rumen. J Anim Sci 1994; 72: 3004-3018.
17. McMahon LR, McAllister TA, Berg BP, Majak W, Acharya SN, Popp JD, Coulman BE, Wang Y, Cheng KJ. A review of the effects of forage condensed tannins on ruminal fermentation and bloat in grazing cattle. Can J Plant Sci 2000; 80: 469-485.
18. Min BR, Barry TN, Attwood GT, McNabb WC. The effect of condensed tannins on the nutrition of ruminants fed fresh temperate forages: a review. Anim Feed Sci Tech 2003; 106: 3-19.
19. Min BR, McNabb WC, Barry TN, Kemp PD, Waghorn GC, McDonald MF. The effect of condensed tannins in Lotus corniculatus upon reproductive efficiency and wool production in sheep during late summer and autumn. J Agr Sci 1999; 132: 323-334.
20. Mueller-Harvey I, McAllan AB. Tannins. Their biochemistry and nutritional properties. In: Advances in plant cell biochemistry and biotechnology, Vol. 1 (Morrison I.M., ed.). JAI Press Ltd., London (UK) 1992; 151-217.
21. Mueller-Harvey I. Tannins: their nature and biological significance. In: Secondary plants products. Antinutritional and beneficial actions in animal feeding (Caygill J.C. and Mueller-Harvey I., eds.). Nottingham Univ Press (UK) 1999; 17-70.
22. Niezen JH, Waghorn TS, Charieston WAG C. Waghorn G. Growth and gastrointestinal nematode parasitism in lambs grazing either lucerne (Medicagosativa) or sulla (Hedysarum coronarium) with contains condensed tannins. J. Agr. Sci. 1995; 125: 281-289.
23. O'Donovan L, Brooker JD. Effect of hydrolysable and condensed tannins on growth, morphology and metabolism of Streptococcus gallolyticus (S. caprinus) and Streptococcus bovis. Microbiol 2001; 147: 1025-1033.
24. Perevolotsky A. Tannins in Mediterranean woodlands species: lack of response to browsing and thinning. Oikos 1994; 71: 333-340.
25. SCALBERT A. Antimicrobial properties of tannins. Phytochemistry 1991; 30:3875-3883.
26. Schofield P, Mbugua DMPell AN. Analysis of condensed tannins: a review. Anim. Feed. Sci. Tech. 2001; 91: 21-40.
27. Silanikove N, Nitsan Z, Perevolotsky A. Effect of a daily supplementation of polyethylene glycol on intake and digestion of tannin-containing leaves (Ceratonia siliqua) by sheep. J Agr Food Chem 1994; 42: 2844-2847.
28. Statistical Analysis System. User's Guide: Statistics, Version 9.1, SAS Institute, NC, USA 2003.
29. Van Soest PJ(ed.). Nutritional ecology of the ruminant, 2nd ed. Cornell Univ Press. Ithaca, NY, USA 1994; 476.
30. Waghorn GC. Condensed tannins and nutrient absorption from the small intestine. Proc of the Canadian Society of Animal Science Annual Meeting, Lethbridge, Canada (Rode L.M., ed.) 1996; 175-194.
31. Wang Y, Douglas GB, Waghorn GC, Barry TN, Foote AG. Effect of condensed tannins in Lotus corniculatus upon lactation performance in ewes. J Agr Sci 1996; 126: 353-362.
32. Wang Y, Waghorn GC, Douglas GB, Barry TN, Wilson GF. The effects of the condensed tannin in Lotus corniculatus upon nutrient metabolism and upon body and wool growth in grazing sheep. Proc N Z Soc Anim Prod 1994; 54: 219-222.

3/5/2011