# Tannin Contents of Some Indigenous Browse Plants of Botswana

A A. Aganga
*Botswana College of Agriculture*

C M. Tsopito
*Botswana College of Agriculture*

K M. Morake
*Botswana College of Agriculture*

# TANNIN CONTENTS OF SOME INDIGENOUS BROWSE PLANTS OF BOTSWANA

A. A. Aganga, C. M. Tsopito and K. M. Morake
Department of Animal Science and Production
Botswana College of Agriculture
Gaborone - Botswana

**ABSTRACT**

A study was carried out to evaluate the tannin content and crude protein degradation of leaves and twigs from indigenous browsable trees which provide feed for grazing livestock on natural rangelands of Botswana. These browses include the families Leguminosae (Acacias), Capparidaceae (Boscias), Combretaceae (Combretum) and Tiliaceae (Grewias). These were found to be of good nutritive value, with the leaves having a high content of crude protein (9 - 16%) and a wide range of dry matter digestibility (37 - 69.82%). The correlation between crude protein disappearance and tannin content was found to be negative (-0.582) and significant ($P<0.05$).

**KEYWORDS**

Tannins, crude protein degradation indigenous browse.

**INTRODUCTION**

Tannins are complex polythenolic compounds with great structural diversity. They have a variable effect in decreasing digestibility of proteins. The diverse effects of tannins on digestion is due to differences in the physiological capabilities of animals to handle them as well as differences in the chemical reactivity of various types of tannins. Some browses are known to contain tannins. Indigenous browseable species play an important role in the nutrition of grazing livestock in Botswana, particularly during the long dry season when grass is unavailable. It is therefore important that the tannin level of the browse plants should be analysed to obtain an estimate of the inhibitory effect on crude protein disappearance in the rumen that would result after consumption of such feed.

**MATERIALS AND METHODS**

Leaves and twigs of twenty different browse species were collected from the rangelands in Kgatleng, Kweneng and central districts of Botswana. The leaves and twigs were dried, ground and sifted through a 2mm sieve. The samples were used for forage quality evaluation using the nylon bag method and tannin determination (Burns and Cope, 1994).

The degradation study was done using a fistulated Simmental Steer. The steer was fed on 1:1 ratio of *Cenchrus ciliaris* chopped hay and lucerne hay *ad. lib*. Duplicate samples were incubated and withdrawn from the rumen after 72 hours. The nylon bag and its contents were washed in cold water and then rinsed in distilled water. The residue was then oven-dried for 48 hours at 70°C and then weighed. The washing loss was determined by soaking samples in water at 38°C for 1 hour followed by the washing procedure above. Dry matter degradability was then calculated.

Chemical analyses of the incubated browse residues and fresh dried browse leaves were carried out in duplicates to determine the crude protein contents using the Kjeldahl technique (AOAC, 1990). Percent crude protein (CP) disappearance in the rumen was obtained by CP content difference between residue and fresh browse samples. The tannin content of the different browse species was determined using the acidified vanillin method (Burns and Cope, 1974). The crude protein disappearance and tannin content data were subjected to correlation analysis using SAS.

**RESULTS AND DISCUSSION**

Table 1 shows the crude protein and tannin contents of the evaluated browse plants. The % CP varied from 9.04 for *Boscia* albitrunca to 16.41 for *Boscia foetida* but *Acacia mellifera* had the highest % CP disappearance in the rumen, while *Ziziphus mucronata* had the highest % dry matter digestibility. The correlation between crude protein disappearance and tannin content was found to be negative (-0.582) and this is significant ($P<0.05$) while the correlation between % DMD and tannin content was also negative (-0.29) but not significant ($P>0.05$).

Tannins are of different forms and bind proteins selectively and have especially high affinity for large proteins, conformationally open proteins and proline rich proteins (Hagerman et. al. 1992). *Acacia burkei* had a low DMD and yet a low tannin level suggesting that the tannins were of an inhibitory nature. *Acacia erubescens* had a relatively low tannin content and a low DMD thus a poor forage plant. The leaves and twigs of *A. erubescens* are browsed by browsing animals including wildlife e.g. springbok. *Acacia fleckii* had an average DMD (48.54%) with a low tannin content of (1.3%) which suggested that *Acacia fleckii* could be a useful forage for ruminant livestock especially during the long dry season of Botswana. *A. fleckii* is one of the most available *Acacia* browse species which thrives well in most vegetational zones of Botswana. *Acacia galphinii* had a low DMD and a very high tannin content with low crude protein disappearance in the rumen. This shows that *A. galpinii* is of poor nutritional value to ruminant livestock. *Acacia giraffae* had a low tannin content and a DMD of 40.32% which suggests that animals may derive some nutritional benefits from the browse specie. *Acacia kirkii* had a high CP value of 16.38% with high tannin content of 6.5% and a low DMD % of 33.13%. The indications of this is that the tannins present in *A. kirkii* are of inhibitory nature to the utilisation of crude protein present in the browse. Thus animals may not benefit immensely from the high CP content of the browse specie.

*Acacia mellifera*, one of the most abundant *Acacia* species in Botswana contains 11.63% CP and 0.9% tannins with 58.51% DMD indicating that the browse has a good forage value. *Acacia robusta* contains high tannins (8.0%) and 10.2% CP and it was moderately digestible suggesting that the tannins are not of an inhibitory type to crude protein digestion. *Bauhania petersiana* contains high tannins (12.1%) but is fairly digestible and the crude protein could withstand microbial degradation in the rumen. It can be inferred that the protein may serve as by-pass protein which can be available for enzymic digestion in the small intestine of the ruminant animal. *Boscia albitrunca* contains low tannins and it was readily digestible but fairly low in protein (9.04%) while *Boscia foetida* contains low tannins and high proteins (16.41%) but not readily digested thus the tannins are likely to be inhibitory in nature. *Combretum apiculation* and *Combretum hereroense* contain high tannins while *Combretum zeyheri* had low tannin content but they were all moderately digestible which suggests that the three *Combretum* species are of good forage value. *Dichrostachys cinerea* had low DMD and high tannin content with a CP value of 13.77% which indicates that the CP may largely be unavailable to the animal. *Grewia flava*, *Grewia retinervis*, and *Ochna pulchra* contain high tannins and *Ochna pulchra* had a low

DMD which suggests that *Ochna pulchra is* of low nutritional value. *Terminalia sericea* and *Ziziphus mucronata* had low tannin contents. They were found to be readily digestible while *Ziziphus mucronata* had a good CP value implying that it is of good nutritional value to the animal.

The concept that protein - tannin interactions are both protein dependent and tannin dependent was demonstrated by Asquith and Butler (1986). Verzele *et. al.* (1986) stated that tannins present in browse leaves may be of different molecular weights. Their tendency to interact with proteins differed, such that those with higher molecular weight have more interactions with proteins making them less available. Hagerman *et. al.* (1992) found that quebracho tannin (commercial tannin), a condensed tannin, diminished protein digestibility in deer and sheep while hydrolisable tannin did not affect protein digestibility.

This study shows that Botswana indigenous browse plants contain varying amounts of tannins which influence the availability to livestock of the protein in the browse species.

**REFERENCES**

**A.O.A.C.** (1990) Association of official analytical chemists. Official methods of analysis, fifteenth edition, Washington DC., pp 152-164.

**Asquith, T.N. and Butler, L.G.** (1986). Interactions of condensed tannins with selected proteins. Phytochemistry **25**, 1591 - 1593.

**Burns, J.C. and Cope, W.A.** (1974). Nutritive Value of Crown-vetch forage as influenced by structural constituents and phenolic and tannin compounds. Agron. J. **66**: 195 - 200.

**Hagerman, A.E., Robbins, C.T., Weerasuriya Y, Wilson, T.C. and McArchur, C.** (1992). Tannin chemistry in relation to digestion. J. Range Management **45**: 57-62.

**Verzele, M., Delahaye, P. and Damme, F.V.** (1986). Determination of the tanning capacity of tannic acids by high - performance liquid chromatography J. Chrom. **362**: 363 - 374.

**Table 1**

Percent crude protein (CP) and tannin content, dry matter digestibility (DMD) and CP disappearance of browse after 72 hours incubation in rumen.

| Browse Species | %CP Leaves and twigs | %CP Residues | %CP Disappearance | % DMD | % tannin |
|---|---|---|---|---|---|
| Acacia burkei | 15.78 | 11.61 | 26.43 | 37.00 | 0.8 |
| Acacia erubescens | 14.81 | 9.55 | 35.52 | 44.38 | 1.9 |
| Acacia fleckii | 12.56 | 8.47 | 32.54 | 48.54 | 1.3 |
| Acacia galpanii | 15.62 | 11.65 | 25.42 | 37.19 | 11.2 |
| Acacia girraffae | 15.65 | 9.44 | 39.68 | 40.32 | 0.5 |
| Acacia kirkii | 16.38 | 11.87 | 27.50 | 33.13 | 6.5 |
| Acacia mellifera | 11.63 | 5.82 | 49.96 | 58.61 | 0.9 |
| Acacia robusta | 10.20 | 6.21 | 39.07 | 49.29 | 8.0 |
| Bauhania petersiana | 13.44 | 11.37 | 15.36 | 52.00 | 12.1 |
| Boscia albitrunca | 9.04 | 6.57 | 27.32 | 68.88 | 0.7 |
| Boscia foetida | 16.41 | 9.77 | 40.46 | 44.38 | 0.4 |
| Combretum apiculatum | 13.33 | 10.56 | 20.71 | 59.88 | 11.2 |
| Combretum hereroense | 9.94 | 7.83 | 21.17 | 52.69 | 12.2 |
| Combretum zeyheri | 11.33 | 7.90 | 30.27 | 30.01 | 1.4 |
| Dichrostachys cinerea | 13.77 | 9.91 | 28.04 | 41.05 | 6.1 |
| Grewia flava | 14.72 | 11.16 | 24.19 | 52.44 | 8.7 |
| Grewia retinervis | 12.10 | 8.49 | 29.83 | 40.25 | 12.7 |
| Ochna pulchra | 10.57 | 8.45 | 20.06 | 34.19 | 10.5 |
| Teminalia sericea | 9.94 | 7.40 | 25.55 | 59.82 | 0.9 |
| Ziziphus mucronata | 12.47 | 9.06 | 27.30 | 69.82 | 0.7 |