NOTA BREVE

DRY MATTER DEGRADATION, TANNIN AND CRUDE PROTEIN CONTENTS OF SOME INDIGENOUS BROWSE PLANTS OF BOTSWANA

TANINOS Y DIGESTIBILIDAD DE MATERIA SECA Y PROTEÍNA DE ALGUNOS FORRAJES LEÑOSOS DE BOSTWANA

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ADDITIONAL KEYWORDS

Capparidaceae (*Boscia*). Combretaceae (*Combretum*). Tiliaceae (*Grewia*).

PALABRAS CLAVE ADICIONALES

Capparidaceae (*Boscia*). Combretaceae (*Combretum*). Tiliaceae (*Grewia*).

SUMMARY

Tannin and crude protein degradation of mature leaves and twigs from 13 indigenous browseable trees and shrubs were evaluated. Tannin determination was done using Vanillin-HCL and Butanol-HCL colorimetric methods. The browses evaluated include the families Capparidaceae (*Boscia*), Combretaceae (*Combretum*) and Tiliaceae (*Grewia*). These browses varied in nutritional values with a 9.04 percent CP for *Boscia albitrunca* while *Boscia foetida* contained 16.41 percent CP. The percentage dry matter digestibility (DMD) varied from 30.01 percent for *Combretum zeyheri* to 69.82 percent for *Ziziphus mucronata*. Condensed Tannin contents (butanol-HCL method) was about 70 percent of values obtained for total tannins (vanillin-HCL method). The tannin contents ranged from 0.26 percent for *Boscia foetida* to 9.5 percent for *Grewia retinervis* (butanol-HCL colorimetric method).

RESUMEN

Se ha evaluado el contenido de taninos y degradación ruminal de la proteína bruta de hojas maduras y brotes de 13 árboles y arbustos. El tanino se determinó mediante los métodos colorimétricos de Vanillina-ClH y Butanol-ClH. Los forrajes evaluados incluyen las familias Capparidaceae (*Boscia*), Combretaceae (*Combretum*) y Tiliaceae (*Grewia*). El valor nutritivo de los forrajes varió desde 9,04 p.100 CP para *Boscia albitrunca* a 16,41 p.100 CP para *Boscia foetida*. La digestibilidad de la materia seca (DMD) varió desde 30,01 p.100 para *Combretum zeyheri* a 69,82 p.100 para *Ziziphus mucronata*. La concentración de taninos condensados (método butanol-HCL) fue de alrededor del 70 p.100 de los valores obtenidos (método vanillina-HCL) para los taninos totales. El contenido de taninos osciló entre 0,26 p.100 para *Boscia foetida* y 9,5 p.100 para *Grewia retinervis* mediante el método butanol-HCL.

INTRODUCTION

Tannins are complex polyphenolic compounds with great structural

diversity. There are two types of tannins based on their chemical structures: condensed and hydrolysable. Condensed tannins or proanthocyanidins are flavonoid polymers while hydrolysable tannins are esters of sugars and gallic acid (gallotannins). Mehansho *et al.* (1987) reported that tannins were found in browse plants, legume seeds and forages and during feeding, some tannins taken in with the food act as a toxin rather than a digestion inhibitor. In some cases tannin-protein complexes are dissociated in the low pH of the abomasum, and an additional source of protein is made available for absorption by the animal. In other cases the tannins protect the proteins from digestion even in the small intestines, hence tannins may have a beneficial effect (increasing bypass protein or decreasing ammonia loss) or a detrimental effect (depressing palatability, decreasing rumen ammonia, decreasing post-ruminal protein absorption on protein availability (Gutteridge and Shelton, 1994). Browse species which contain some tannins will therefore provide both degradable and undegradable rumen nitrogen and will be more effective sources of supplemental nitrogen for ruminants. If tannins are present in moderate amounts in legumes they improve the assimilation of proteins and prevents bloating. 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 13 different browse species were collected from the rangelands in Kgatleng, Kweneng and Central District 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 was done using vanillin-HCL method (Burns and Cope, 1974) and butanol-HCL method (Makkar, 1995).

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*. Nylon bags measuring 8 x 14cm made from dacron filter cloth (LT075 Locker Wire Weavers, P.O. Box 161, Warrington WA1 2SU) with pore size varying from 45 to 60m were used for the degradation study. The samples were incubated in duplicates and withdrawn from the rumen after 72 hours. The nylon bag and its contents was washed in cold water and then rinsed in distilled water. The residue was then oven dried for 48 hours at 70ºC and then weighed. The washing loss was determined by soaking samples in water at 38ºC 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 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 and butanol-HCL extraction method (Makkar, 1995). Means of tannin values obtained were tested for significant differences using ANOVA in SAS.

RESULTS AND DISCUSSION

Data in **table I** shows the crude protein and tannin contents of the evaluated browse plants. The percent CP varied from 9.04 from *Boscia albitrunca* to 16.41 for *Boscia foetida* which had the highest percent CP disappearance in the rumen (40.46 percent), while *Ziziphus mucronata* had the highest percent dry matter digestibility.

The tannin contents varied based on method of determination. **Table I** shows the percentage tannins in the 13 browse species determined by colorimetric methods using vanillin-HCL method and Butanol-HCL method. Vanillin-HCL method is not specific since it extracts the condensed tannins as well as simple flavonoids. The other method for condensed tannins is a chemical one in which the proathocyanidins are oxidatively depolymerised in a Butanol-HCL mixture into anthocyanidins which is good for indicating the chemical nature of tannins present. The percent tannin contents

Table I. *Percentage crude protein, total (T) and condensed (C) tannin contents, dry matter digestibility (DMD) and crude protein disappearance of browse after 72 hrs incubation in rumen*. (Porcentaje de proteína bruta, contenido de taninos totales (T) y condensados (C), digestibilidad de la materia seca (DMD) y desaparición de la proteína bruta de los forrajes leñosos después de 72 horas de incubación en el rumen).

	percent crude protein			percent	T. Tannin	C. Tannin
	Leaves-twigs	Residues	Disappearance	DMD	Vanillin-HCL	Butanol-HCL
Bauhania petersiana	13.44	11.37	15.36	52.00	12.1	9.15
Boscia albitrunca	9.04	6.57	27.32	68.88	0.7	0.40
Boscia foetida	16.41	9.77	40.46	44.38	0.4	0.26
Combretum apiculatum	13.33	10.56	20.71	59.88	11.2	8.5
Combretum hereroense	9.94	7.83	21.17	52.69	12.2	8.0
Combretum zeyheri	11.33	7.90	30.27	30.01	1.4	0.8
Dichrostachys cinerea	13.77	9.91	28.04	41.05	6.1	4.5
Grewia flava	14.72	11.16	24.19	52.44	8.7	6.2
Grewia retinervis	12.10	8.49	29.83	40.25	12.7	9.5
Ochna pulchra	10.57	8.45	20.06	34.19	10.5	8.82
Teminalia sericea	9.94	7.40	25.55	59.82	0.9	0.65
Ziziphus mucronata	12.47	9.06	27.30	69.82	0.7	0.60
Kirkia accuminata	9.46	6.05	36.05	39.85	3.20	1.28

using Butanol-HCL are significantly different which ranges from 0.26 percent for *Boscia foetida* to 9.5 percent for *Grewia retinervis*. Barry (1989) stated that low concentrations of tannins ≤ 3 percent DM are thought to be beneficial due to their effect in reducing rumen degradation of forage proteins. Wiseman and cole (1988) stated that high tannin levels are quite deleterious in the nutrition of monogastric animals since they reduce the absorption of protein from the small intestine. The tannin percentage using Vanillin-HCL are relatively higher since it determines the simple flavonoids and they are speculated to have the same effect as the tannins from Butanol-HCL method. The amount of tannins from this method ranges from 0.4 percent for *Boscia foetida* to 12.7 percent for *Grewia retinervis* which are different ($p<0.05$). Bauhania petersiana contains high tannins (12.1 percent) from Vanillin-HCL method and 9.15 percent) from butanol-HCL method but fairly digestible and the crude protein could withstand microbial ruminal degradation. 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 percent) while *Boscia foetida* contains low tannins and high proteins (16.41 percent) but not readily digested thus the tannins are likely to be inhibitory in nature. *Combretum apiculatum* 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 percent which indicates that the CP may largely be un-available 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 hydrolysable tannin, did not affect protein digestibility. Also, Robbins *et al.* (1991) observed that tannins formation of indigestible complexes with protein varies with animal species.

CONCLUSION

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. The fate of condensed tannins present in these browse plants as relates to their metabolism requires an in-depth study before some of the browse species can be recommended for propagation.

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