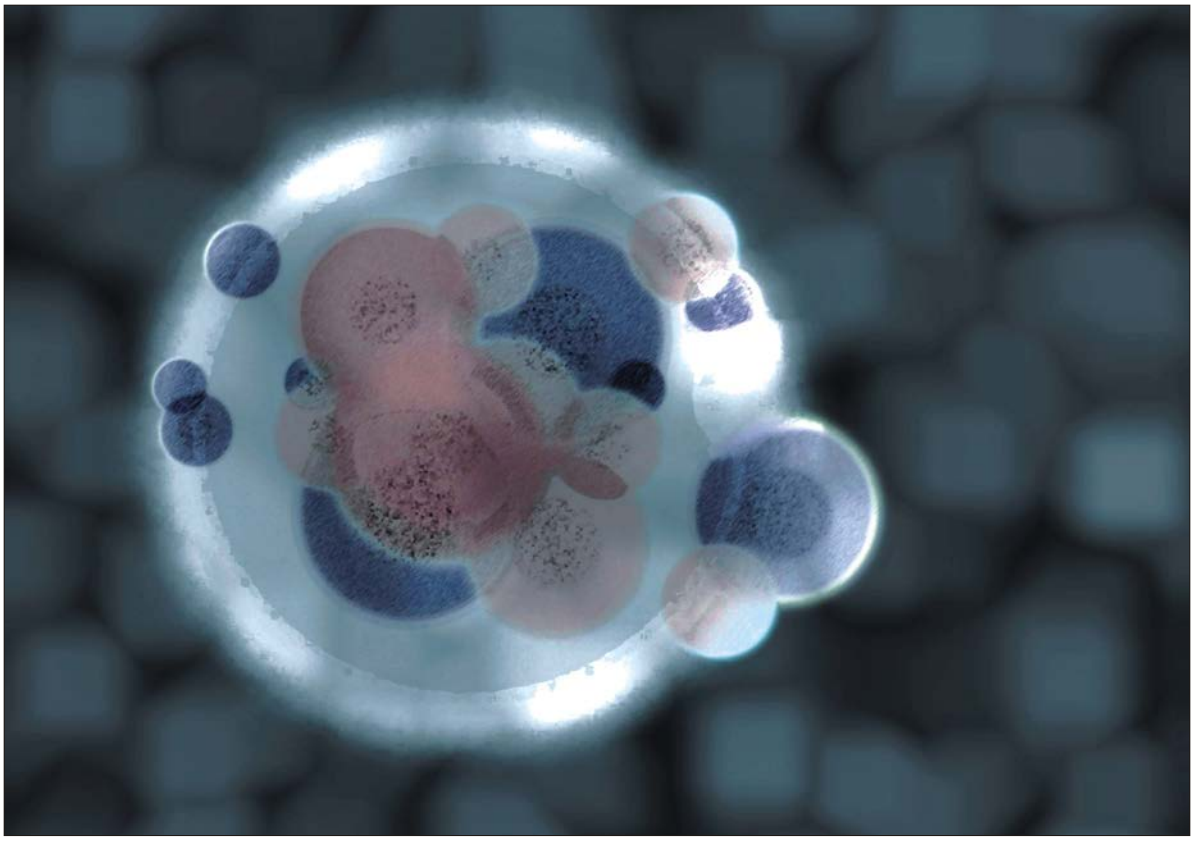

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Nutrient Balance of Tswana Goats Fed *Cenchrus ciliaris Hay* as Basal Diet and *Terminalia serecia* or *Boscia albitrunca* as Supplement

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Abstract: In a metabolism trial study conducted at the Botswana College of Agriculture's farm, twenty yearling Tswana goat castrates were used to determine the digestibility of diets containing two browse plants namely *Terminalia serecia* or *Boscia albitrunca* fed along with *Cenchrus ciliaris* and wheat bran. The browse plants were obtained from Sebele rangelands which were analyzed for proximate composition and evaluated for *in vivo* dry matter digestibility using Tswana goats. The animals were divided into five groups the control group and four treatment groups. Control group was offered per animal 800 g of lucerne while the treatment groups were offered; 400 g *B. albitrunca*, 800 g *B. albitrunca*, 400 g *T. serecia* and 800 g *T. serecia*, respectively. Buffel grass hay was offered at 400 g and 250 g wheat bran per goat for all groups and clean water was available at *ad libitum*. Percentage crude protein values obtained were 10.4, 6.84, 5.72 and 6.11 for lucerne (*Medicago sativa)*, *Cenchrus ciliaris*, *Terminalia serecia* and *Boscia albitrunca*, respectively. The dry matter digestibility coefficients obtained for the goats were 0.692, 0.545, 0.481, 0.412 and 0.490 for control group, treatments 1, 2, 3 and 4, respectively.

Key words: Tswana goats, nutrient balance, lucerne, *Cenchrus ciliaris*, *Terminalia serecia*, *Boscia albitrunca*

INTRODUCTION

The parts of tree fodder commonly used as feed is referred to as browse which can be defined as the tender shoots, twigs and leaves of shrubs and woody plants and also fruits and pods (Aganga and Tshwenyane, 2003). Browses form an important part of the goats' diets in the tropics especially in rural areas where goat meat is a major source of protein (Devendra and McLeroy, 1982). Animal production in Botswana suffers from inadequate feed quantities and qualities; due mainly to low annual rainfall which barely supports arable farming in most years (Aganga and Tshwenyane, 2003). In the savanna, the main period of vegetative growth of many woody species is shortly before the wet season. At this time, the leaves are soft, young and relatively rich in nutrients and other forage resources are over mature or already consumed. Browse is particularly valuable at this time of the year (Bayer and Waters-Bayer, 1998). The Dry Matter (DM) intake of goats indicates their capacity to utilize feed voluntarily. Devendra and McLeroy (1982) stated that meat goats in the tropics seldom exceed an intake of 3% of their live weight . Goats commonly browsed plants in Botswana rangelands include; *Boscia albitrunca* and *Terminalia sericea* among others. These browse plants contain tannins which are phenolic compounds that precipitate proteins. They are composed of very diverse group of oligomers and polymers. Grazing goats in the tropical rangelands base their diets on tree-leaves and shrubs (browse) which ensure reliable and steady supply of food all year round, albeit, of low to medium quality. The indigenous Tswana goats are an integral part of the smallholder farming system in Botswana. In particular a large number of the farming families in Botswana keep indigenous Tswana goats. The adult male Tswana goat weighs about 30 kg and female 25 kg, average height at withers being 60-65 cm. The foliage of trees and shrubs is frequently stated to be high in mineral content and nutritive value compared to grasses which are subject to seasonal fluctuations. Indigenous browse-able 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 level of tannin in browse plants should be analyzed to obtain an estimate of the inhibitory effect on crude protein and other nutrients digestion. The objective of the study was to determine nutrient digestibility and retention by Tswana goats consuming *Cenchrus ciliaris*, *Terminalia serecia* and *Boscia albitrunca*.

MATERIALS AND METHODS

The study was conducted at the Botswana College of Agriculture's farm in Gaborone. The study took twenty one days with goats in metabolism trials. Twenty male castrate Tswana goats aged nine months with average

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Table 1: Quantity of feeds fed to animals

Animal group	Buffalo grass as basal diet (400 g/goat)	Wheat bran (250 g)	Water offered (4000 L)	Legume supplement
Control	✓	✓	✓	Lucerne (800 g)
Treatment 1	✓	✓	✓	*B. albitrunca* (400 g)
Treatment 2	✓	✓	✓	*B. albitrunca* (800 g)
Treatment 3	✓	✓	✓	*T. serecia* (400 g)
Treatment 4	✓	✓	✓	*T. serecia* (800 g)

weight of 25.5 kg were used in the study. The animals were randomly allocated to the treatments (Table 1) and housed in individual metabolic crates placed in a large pen with concrete floors, common roof made of corrugated roofing sheets and dwarf walls to allow for ventilation. Feed, faecal and urine chemical composition analyses were conducted in the laboratory using the procedures of AOAC (1996). The goats were divided into 5 groups consisting of a control group and four treatment groups with four replicates per group making a total of 20 animals. The browse plants were cut a day before feeding to allow for wilting.

The crude protein contents for the two browse plants, grass, lucerne and wheat bran were determined using the procedure of AOAC (1996) while tannins were determined using the International Atomic Energy Agency procedure (Makkar, 1995). The study was a 21 day digestibility trial consisting of 7 days adjustment period and 14 days collection period. During the collection period data on feed offered, feed left over, water offered, water left over, urine output and faeces out put were collected. Urine was collected over 25 mL of 37% hydrochloric acid and 25 mL of toluene. After measuring, 10% of urine and faeces collected daily was frozen and at the end of the collection period were pooled for each animal and sub-sampled for chemical analysis (AOAC, 1996). Urine was analyzed for nitrogen while faeces was analyzed for nitrogen (N), calcium (Ca), phosphorus (P) and magnesium (Mg). Feed offered was also analyzed for N, Ca, P and Mg, then coefficients of digestibility and nutrient retention values for nitrogen, Ca, P and Mg were calculated. Calcium and magnesium were determined using an atomic absorption spectrometer while ultra violet spectrometer was used to determine Phosphorus (AOAC, 1996).

Statistical analysis: The data was subjected to Analysis of Variance (ANOVA) and the Duncan's multiple range tests (SAS,1995).

RESULTS AND DISCUSSION

Percentage composition: Results of Table 2 showed that dry matter content varied from 87% for wheat bran (supplementary energy feed) to 41.1% for *Terminalia serecia*. Crude protein content was 5.72% for *Terminalia serecia* and 6.1% of *Boscia albitrunca* while tannin content of the two browse plants were 0.32% for *B. albitrunca* and 4.13% for *T. serecia*.

Table 2: Percentage chemical composition of feeds (g/100 g on dry matter basis

Name of feedstuff	DM	CP	TANNIN	P	Ca	Mg
Medicago sativa	86.9	10.40	-	0.22	1.06	0.28
Cenchrus ciliaris	87.0	6.84	-	0.22	0.94	0.32
Terminalia serecia	41.1	5.72	4.13	0.082	1.302	0.014
Boscia albitrunca	55.5	6.10	0.32	0.062	1.004	0.012
Wheat bran	87.0	9.00	-	0.185	0.074	0.83

Medicago sativa (Lucerne) and Buffalo grass (*Cenchrus ciliaris)* had a DM% of 86.9% and 87% respectfully. CP content was 10.4 for lucerne and 6.84 for buffalo grass hay.

Livestock production in Botswana is mostly dependent on the range. The animals are let to graze on the open ranges. The rainy season of the country is short with a prolonged dry season which last for eight months of the year. During the dry season most of the grass is either grazed or lost its nutritive value and this makes the feeding of browse plants important at this time. These browse plants retain their nutritive value.

Goats are efficient feeders which can switch their diet across the available feeds and their diet is comprised mostly of browse plants. Their ability to digest tannin containing feeds enables them to feed on various browse plants which can supplement each other in mineral contents. This explains the reason why goats usually appear in good conditions over the year even when the nutritive value of the vegetation has declined.

From the nutritional analysis the browse plants had fairly high nutrients and the values agreed with the reports of Aganga *et al.* (1998 and 2000). The tannin content of the two browse plants/trees used in the study ranged from 0.32 of *B. albitrunca* to 4.13 of *T. serecia* which are similar to values reported by Aganga *et al.* (2000) for *Albizia harveyi* and *Acacia albida*, respectively.

The goats in the control group had dry matter digestion coefficient of 0.692, Nitrogen digestion coefficient was 0.4835. Treatment 1 which was fed *B. albitrunca* at 400 g had a dry matter digestion coefficient of 0.545 which means that 54.5% dry matter was digested. The tannin contained in this browse did not have any negative effects on the metabolism of Tswana goats used in the study. When compared to goats in treatment 2 which was fed 800 g of *B. albitrunca*. Also for treatment 3 and 4 dry matter digestion coefficients of 0.412 and 0.490 were obtained, respectively. Devendra and McLeroy (1982) stated that the ability of goats to utilize

Table 3: Nitrogen metabolism data, DMD for tswana goats fed on *Cenchrus ciliaris* as basal diet and *T. serecia* or *B. albintrunca* or lucerne as supplements

Treatments	Control	1	2	3	4	SE*
Nitrogen intake (g kg^{-1})	0.6075a-c	0.7405bc	0.9166a	0.8254bc	0.9817c	0.5339
Faecal N	0.1245a-c	0.1293a-c	0.108b	0.0225ab	0.0213ab	0.6777
Urinary N	0.1095ab	0.2231b	0.1393ab	0.0145c	0.0298c	0.667
Excreted N	0.234	0.3524	0.2473	0.037	0.0511	0.6517
N retention	0.3735ab	0.3881ab	0.6693a-c	0.7884a-c	0.9306a	0.5703
Digestible N	0.483	0.6112	0.8086	0.8029	0.9604	0.5495
CP apparent digestibility	0.641a	0.573b	0.681a	0.516b	0.505b	0.4192
DMD (coefficient)	0.692a	0.545a	0.481b	0.412c	0.490c	0.5494

abc-means with the different letter(s) in the same row are significantly different at $p<0.05$, *SE = Standard Error

Table 4: Calcium metabolism data for tswana goats fed on *Cenchrus ciliaris* as basal diet and *T. serecia* or *B. albintrunca* or lucerne as supplements

Treatments	Control	1	2	3	4
Ca intake (g kg^{-1})	0.9784a	0.5602b	0.7034b	0.6862b	0.8267a
Faecal Ca	0.1323a	0.2099b	0.1513b	0.1803b	0.0504a
Ca retention	0.8461c	0.3503a	0.5521b	0.5659b	0.7763c
Ca apparent digestibility	0.8646a	0.6259b	0.785a	0.648b	0.813a

Means in the same row having different letter(s) are significantly different at $p<0.05$

Table 5: Phosphorus metabolism data for for tswana goats fed on *Cenchrus ciliaris* as basal diet and *T. serecia* or *B. albintrunca* or lucerne as supplements

Treatments	Control	1	2	3	4
P intake (g kg^{-1})	0.2667b	0.1416a	0.1478a	0.1646a	0.1399a
Excreted P(faecal)	0.1149b	0.0136a	0.0214a	0.0209a	0.0204a
P retention	0.1518a	0.128b	0.1264b	0.1437a	0.1195b
P apparent digestibility	0.861	0.904	0.855	0.873	0.8544

Means in the same row having different letter(s) are significantly different at $p<0.05$

Table 6: Magnesium metabolism data for Tswana goats fed on *Cenchrus ciliaris* as basal diet and *T. serecia* or *B. albintrunca* or lucerne as supplements

Treatments	Control	1	2	3	4
Mg intake (g kg^{-1})	0.4832b	0.3163c	0.3123c	0.3456c	0.3386c
Mg excreted(faecal)	0.1245a	0.1465b	0.1535b	0.1465b	0.1508b
Mg retention	0.3587a	0.1698b	0.1588b	0.199c	0.1878c
Mg apparent digestibility	0.7423a	0.5369c	0.508c	0.576c	0.555c

Means in the same row having different letter(s) are significantly different at $p<0.05$

browse plants containing tannins and other phenolic compounds depend on the ability to produce saliva which contains some mucins that interact with these compounds.

The crude protein value of a feed only provides a measure of the nitrogen present in the food but gives little indication of its value to the animal but the digestibility as shown in this study provides an insight into the utilization of the nutrients by the animals. Before the nutrients in a feed becomes available to the animal it goes through metabolic processes and the different quantities of nitrogen in the feed and waste (faeces and urine) show the proportion digested and utilized which is shown in Table 3.

Calcium, phosphorus and magnesium digestion coefficients in the feeds used in this study are shown in Table 4-6. The data obtained showed that the minerals were digested and utilised in large amounts rather than being excreted. The minerals were utilised at a high rate because the animal body cannot synthesis them and the diet served as good sources of these essential minerals. The study showed that feeding browse plants to livestock could provide a solution to feed shortage in the tropics especially during dry seasons when the nutritive values of most grasses have declined and the nutrients present in the browses are utilized by the goats. The knowledge of these fodder plants' nutritive value and the level of supplementation and digestibility are required if these fodder trees are to become important feed resources.

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