

PERFORMANCE OF TSWANA GOATS FED *ACACIA MELLIFERA*, *EUCLEA UNDULATA*, AND *PELTOPHORUM AFRICANUM* AS A SUPPLEMENT TO BUFFEL GRASS

A.A. Aganga, U.J. Omphile and L. Baleseng

Department of Animal Science and Production, Botswana College of Agriculture, P/Bag 0027, Gaborone, Botswana

SUMMARY

The experiment was conducted at Botswana college of Agriculture content farm, from early February to mid May 1999 (period of 90 days). Twenty-eight Tswana male (castrated) goats weighing on average 14 kg were used. The goats which were of average age of 7 months were balanced for weight and then allocated to four groups of seven animals randomly (completely randomised design). The goats were individually housed under a common roof. Lucerne was used along with *Peltophorum africana*, *Euclea undulata*, and *Acacia mellifera*, as supplement while buffel grass was given to all goats. The grass hay constituted 40% of the ration and Lucerne or the browses made up the remaining 60%. Water was made available daily. However, both the water and feed left were measured and recorded each day before the next meal was offered. Weighing of experimental goats was done bi-weekly before feeding. The data collected was subjected to statistical analysis.

The results show that daily body weight gain (g) was statistically significant ($P < 0.05$). Thus, goats fed on *Acacia mellifera* had a slightly more body weight gain of 45 g/day, followed by Lucerne with 43 g/day, *Euclea undulata* 41 g/day and the least was *Peltophorum africana* with 26 g/day. Treatments effects on average daily dry matter intake were highly significant ($P < 0.05$). Goats on *Euclea undulata* had the highest intake of 700.97 g/day. The average daily browse intake were highly significant at ($P < 0.05$) with *Euclea undulata* having 471.44 g/day and both *Acacia mellifera* and *Peltophorum africana* having lowest intake of 399.91 g/day 416.48 g/day respectively. There was no significant difference ($P > 0.05$) on average daily water intake under the different treatments. There was also no significance difference in feed conversion ratio ($P > 0.05$). The study showed that *Acacia mellifera*, *Peltophorum africana*, and *Euclea undulata* can be used as alternative source of nutrients and minerals in goat nutrition especially during the dry season.

Keywords: Tswana goats fed *acacia mellifera*, *euclea undulata*, and *peltophorum africanum*

INTRODUCTION

Browse is a foliage, bark and twigs of shrubs and trees eaten by livestock. Goats, like all ruminants, are forage eaters with a gut system particularly adapted to a large intake of plant materials. The most important factors that are considered responsible for the goat's ability to utilize a wide variety of vegetation are its high tolerance of bitter substances compared to other ruminants (Church and Goacher, 1970), the high mobility of the upper lip which enables the goat to select palatable feed, particularly when grazing on thorny shrubs, and its bipedal standing during browsing. According to Mowlem (1988), goats if given a free choice prefer browse species, i.e shrubs, bushes, and weeds, rather than grass or clover. The value of browse to goats was stated by Devendra and Burns (1983), when they indicated that from extensive field observations, goats and sheep start grazing as a mixed flock, but soon separate, with goats tending to wander further than the sheep, presumably in search of browse and other herbage.

Carrera (1971) observed that, in the arid zones of Mexico, 1728 goats bites in a mixed brush grass forb community revealed that 83% of the bites were on browse and forbs, and 17% on grass. Bell (1978), through rangeland studies, showed that the goat's diet to be composed of 60% trees and shrubs, 20% grasses and 20% forbs. In contrast, sheep and cattle preferred only 10% browse in their diet with grasses and forbs contributing respectively, 60 and 30% of the sheep diet and 70 and 20% of the cattle diet. Browse (leaves and twigs of trees and shrubs) and forbs generally contain higher levels of crude protein and phosphorus during the growing season than do grasses (Aganga and Monyatsiwa, 1999).

Acacia mellifera is widespread in Africa (occurring in Egypt, Angola, Botswana and Tanzania) usually on clay soils. Goats are very fond of the leaves, which are either browsed from the standing shrubs or are picked up when they fall to the ground normally during the dry season (Skerman, 1977).

Euclea undulata is a dense twiggy shrub or a small tree up to 7m in height, occurs on open rocky slopes, in open acacia woodland. According to Palgrave (1983) leaves make a useful fodder for stock but bark contain tannin.

Peltophorum africanum is a small to medium sized tree with a spreading crown, 5 to 10 m in height with beautiful and distinctive flower and the gum is poisonous (Palgrave, 1983).

MATERIALS AND METHODS

The experiment was conducted at Botswana College of Agriculture Content Farm, from early February to mid May 1999 (90 days). Twenty-eight Tswana male (castrated) goats weighing on average 14 kg were used. The goats which were of average age of 7 months were balanced for weight and then allocated to four groups of 7 animals randomly (completely randomised design). The goats were dewormed with a broad spectrum anthelmintic and dipped for ectoparasites before the experiment and they were then individually penned under a common roof. The goats were, also, given a week to acclimatise to their pen environment and experimental diets.

Buffel grass hay (*Cenchrus ciliaris*) was fed along with lucerne (*Medicago sativa*) to the control group. The other three treatments were supplemented with three browse species: *Euclea undulata*, *Peltophorum africanum*, and *Acacia mellifera*. Buffel grass hay constituted 40% of the ration and the protein source (Lucerne, *Euclea undulata*, *Peltophorum africana*, *Acacia mellifera*) constituted 60% of the ration offered to the goats daily on dry matter basis. However, all goats were provided with mineral block *ad libitum*. Cleaning of pens and removal of left-overs of the previous day was done daily before placement of the day's ration. Both water and feed left were measured daily and recorded. The volume of water given and left over was measured daily using a measuring cylinder and a platform electronic scale was used to measure the feed given and left over. Goats were weighed individually every two weeks before the morning feed using an Avery walk-in scale.

The treatments were

Control: 40% Buffel grass hay and 60% Lucerne (*Medicago sativa*) were fed to control group.

Treatment one: 40% Buffel grass hay and 60% *Acacia mellifera*.

Treatment two: 40% Buffel grass hay and 60% *Peltophorum africanum*.

Treatment three: 40% Buffel grass hay and 60% *Euclea undulata*.

Feedstuff Analysis

Dry matter was determined as the weight remaining which resulted from drying a known weight of feed sample in an oven at 40° C for 96 hrs using the procedures of A.O.A.C. (1995). Minerals were determined using an atomic absorption spectrophotometer (GBC 908 AA, Scientific equipment Pty Ltd, Dandenong, Victoria, Australia) and a flame photometer (Ciba-corning flame photometer 410) as described by A.O.A.C. (1995). Ash was also determined by using procedures of A.O.A.C. (1995). Acid detergent fibre (ADF), Neutral detergent fibre (NDF) and Acid detergent lignin (ADL) were determined by methods of Goering and Van Soest (1970). Dry matter digestibility was determined using an *in vitro* method (Tilley and Terry, 1963).

Nitrogen content in each feed sample was determined using the Kjeldahl method and protein was calculated as nitrogen (N) multiplied by 6.25. Condensed tannins were determined using the Colorimetric determination method as described by Makkar (1999). Thus, condensed tannins were determined using aqueous acetone extracts, and butanol-HCl to estimate the amount of condensed tannins in the colorimeter. The data collected were subjected to analysis of variance, following the procedures of Steel and Torrie (1980).

RESULTS AND DISCUSSION

Lucerne comprised a high crude protein content 11.4 %, while crude protein in browse plants ranged from 5.9 % to 10.3 %. Table 1, also shows the *In vitro* dry-matter digestibility (IVDMD), ADF, ADL, NDF, Ash and tannins. With regard to IVDMD, *Euclea undulata* was more digestible (73%) and the least digestible was buffel grass (48%). NDF content was highest in buffel grass with 71 %, followed by *Acacia mellifera* (51.7%), Lucerne (48%), *Euclea undulata* (35%) and *Peltophorum africanum* (34%). *Acacia mellifera* contained high ADF (42.7%) and Lucerne had lower ADF value of 38.5%. The ADL in browse plants ranged from 10.7% to 16.7%. The grass hays contained more ash than the browse plants. With respect to tannins *Euclea undulata* had more tannins (1.24%), followed by; *Peltophorum africanum* (0.44%), *Acacia mellifera* (0.2%) and buffel grass (0.07%), Lucerne (below detectable level). Calcium content in browse plants ranged from 11 g/kg to 13 g/kg. Calcium content in grass hay was 2.9 g/kg and lucern had 8.4 g/kg. Potassium was generally high in all feeds while sodium was generally low in all feeds provided. *Euclea undulata* had the highest content of magnesium (1.7 g/kg) and Buffel grass the lowest (0.9 g/kg).

Table 1. Percentage of chemical composition of feeds used in the tested diets

	Lucerne hay	Buffel grass hay	<i>Peltophorum africanum</i>	<i>Acacia mellifera</i>	<i>Euclea undulata</i>
CP	11.4	6.1	6.8	10.3	5.9
NDF	48.0	71	34	51.7	35.0
ADF	38.5	41	40.5	42.7	38.7
ADL	10.0	5.0	15.3	10.7	16.7
IVDMD	65.0	48.0	67.0	49.0	73.0
Ash	7.7	9.6	5.2	5.7	5.7
Tannins	-	0.07	0.44	0.2	1.24

Table 2. Mineral composition of feeds used in tested diets

Feed	Macro minerals (g/kg)					Micro minerals (mg/kg)			
	Mg	Na	P	Ca	K	Zn	Fe	Mn	Cu
<i>A. mellifera</i>	1.4	0.5	2.0	11.0	17.3	1.3	943	56	6.3
<i>E. undulata</i>	1.7	0.9	0.8	6.7	10.9	0.8	870	190	4.5
Lucerne	1.2	0.2	2.7	8.4	12.5	1.0	380	53.8	9.5
Buffel grass	0.9	0.5	2.5	2.9	17.4	0.9	843	184.3	12.0
<i>P. africanum</i>	1.3	0.3	0.8	13.0	10.1	1.5	1407	200.3	16.5

Table 3 shows data on feed conversion ratio, daily dry matter intake, growth, and daily water intake of the goats during the experimental period.

Table 3. Intake and response of Tswana goats during the experimental period

Feed types	Control	Treatment one	Treatment two	Treatment three
	B. grass+ Lucerne	B. grass+ <i>A. mellifera</i>	B. grass+ <i>P. africanum</i>	B. grass+ <i>E. undulata</i>
Initial body weight(kg)	9.80±1.24 ^a	10.80±1.11 ^a	12.80±0.66 ^a	11.80±0.58 ^a
Final body weight(kg)	13.40±1.36 ^a	14.60±0.74 ^a	15.00±0.71 ^a	15.20±0.86 ^a
Body weight gain(kg)	3.6± 1.21 ^a	3.8±0.86 ^a	2.2±0.38 ^a	3.4±0.4 ^a
Average daily weight gain(g)	43.0±1.4 ^a	45.0±1.0 ^a	26.0±0.4 ^b	41.0±0.5 ^a
Metabolic weight (kg w ^{0.75})	6.26±0.48 ^a	6.72±0.34 ^a	7.19±0.25 ^a	7.03±0.28 ^a
Average daily feed intake(g)	457.0± 12.87 ^a	381.6±15.87 ^b	422.3±16.77 ^a	459.6±21.48 ^a
Av. daily Buffel grass intake (g)	189.8±5.39 ^b	186.4±5.11 ^b	229.1±7.92 ^a	229.5±7.05 ^a
Average daily Legume intake(g)	267.2±8.29 ^a	195.2±11.74 ^c	193.2±11.83 ^c	230.1±14.58 ^b
Average daily water intake(ml)	1147.97±41.32 ^a	1127.56±41.6 ^a	1135.93±38.38 ^a	1135.84±38.78 ^a
Feed conversion Ratio(g/g)	10.63±5.10 ^b	8.48±2.76 ^b	16.24±4.97 ^a	11.21±2.22 ^b
Av. water intake (ml/kg w ^{0.75})	189.59±20.4 ^a	169.29±7.46 ^a	158.96±7.07 ^a	162.59±7.2 ^a
DM intake (g)/kg w ^{0.75}	73.0±4.95 ^a	56.8±5.24 ^c	58.7±1.34 ^c	65.4±4.43 ^b

Mean standard error *Means in the same row having different superscript are significantly different (P < 0.05).

According to the results, treatments effects on average daily dry matter intake were highly significant (P<0.05), goats on *Euclea undulata* had the highest intake of 459.6 g/day and those supplemented with *A. mellifera*, had the least intake of 381.6 g/day. Treatment effects on average daily browse intake were significant (P<0.05), but there was no significant difference between *Acacia mellifera* and *Peltophorum africanum*, however there was significant difference (P < 0.05) between *Euclea undulata* and the two other browsable plants (*A. mellifera* and *P. africanum*). Lucerne intake was significantly higher than the intake of all browsable plants (267.2 g/day). There were also high significant differences (P < 0.05) in the average daily Buffel grass intake. The control goats (on Lucerne) had a significantly lower intake than goats on *Peltophorum africanum* or *Euclea undulata*. The intake of *Peltophorum africanum* and *Euclea undulata* had no significant difference (P > 0.05) on average daily grass intake. In fact the highest grass hay intake was 229.53 g/day. There was no significant difference (p > 0.05) on average daily water intake under the different treatments. The intake was almost the same. It was shown in Table 3 that there was no significant difference (P > 0.05) in body weight gain, and metabolic weight. However, it was shown that the mean for the average daily weight gain of treatment two was significantly different (P < 0.05) compared to that of the other treatments. Goats on *Acacia mellifera* had a slightly more body weight gain of 45 g/day, followed by lucerne with 43 g/day, *Euclea undulata* 41 g/day and the least was group fed with *Peltophorum africanum* with 26 g/day. It was also found that average dry matter intake expressed on basis of metabolic weight was significant (P < 0.05) for the treatments. Goats fed on lucerne as supplement had the highest intake of 73.0 g/kg w^{0.75} followed by *Euclea undulata* 65.4 g/kg w^{0.75}, *Acacia mellifera* 56.8 g/kg w^{0.75} and *Peltophorum africanum* 58.7 g/kg w^{0.75}. The growth rate of the goats fed on lucerne, *Acacia mellifera* and *Euclea*

undulata as supplements were similar but those of goats fed on *Peltophorum africanum* had very low weight gains.

This study shows that browse plants can provide a valuable food source and can be used to supplement low quality forages like buffel grass. The weight gains of Tswana goats fed *A.mellifera* and *E.undulata* were similar to those fed lucerne as a supplement, showing that Tswana goats can utilize these browses as efficiently as they utilize lucerne.

REFERENCES

- Aganga, A.A. and C.B. Monyatsiwa, 1999. Use of browses (*Terminalia serecia*, *Combretum apiculatum* or *Euclea schimperi*) as a supplement for growing Tswana goats. *Tropical Anim. Health and Prod.* 31:295-305.
- AOAC, 1995. Official Methods of Analysis, 16th edition, (Association of Official Analytical Chemists, Arlington, VA).
- Bell, H.M 1978. Rangeland Management of Livestock Production 2nd edition. Univ. Oklahoma press, Norman.
- Carrera, C., 1971. Types of Plants Consumed by Goats. In XI informe de investigation, Escuela de Agricultural Ganderia, Instituto Tecnologico de Estudios superiores de Monterrey, 1969 to 1970, 152-155 (ABA 40, 2000).
- Church, D.C and Goacher, W.D, 1970. Taste responses in ruminants. IV. Rections of pygmy goats, normal goats, sheep and cattle to acetic acid and quinine hydrochloride. *Journal of animal science* 31, 373-382.
- Devendra, C and Burns Marca, 1983. Goat production in the tropics, commonwealth agricultural Bureaux, farm house, UK.
- Goering, H.K. and Van soest, P.J, 1970. Forage fibre analysis, (Agricultural handbook No.379. USDA, Washington DC).
- Makkar, H. P. S. 1999. Quantification of tannins in Tree Foliage: A laboratory manual for the FAO/IAEA Co-ordinated project . Nuclear Techniques in Food and Agriculture, Animal Prod. And Health Sub-Programme. FAO.
- Mowlem, Alan, 1988. Goat Farming, Farming press book, UK.
- Palgrave, K.C. 1983. Trees of Southern Africa, Struik publishers, Cape Town, S.Africa.
- Skerman, P.J., 1977. Tropical forage legumes, FAO. Rome, Italy.
- Steel, R.D and Torrie, J.H. 1980. Principles and Procedures of Statistics: A Biometrical approach, 2nd edition, Mc Graw-hill publishing company incorporated, New York, USA.
- Tilley, J.M.A and Terry, R.A. 1963. A two stage technique for in-vitro digestibility of forage crops. *Journal of the British grassland society*, 18:104-111.