

Utilization of Sorghum Forage, Millet Forage, Veldt Grass and Buffel Grass by Tswana Sheep and Goats when Fed *Lablab purpureus* L. as Protein Supplement

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ABSTRACT : Forty yearling Tswana sheep and goats (20 sheep and 20 goats) of both sexes were used in a feeding trial conducted in Botswana College of Agriculture (B.C.A) Content Farm in Gaborone for three months. The animals were randomized into four treatment groups of five animals per species balancing for weight and sex such that average initial weights were not statistically different. The sheep and goats were individually housed and fed under a common roof. All the animals were fed on *Lablab purpureus* L. as a protein supplement which was 40% of the ration. In addition to *L.purpureus* L. the control groups of both species were fed on 60% *Cenchrus ciliaris* L. as basal diet. The other three treatment groups were fed on different forages namely; sorghum forage (*Sorghum sudanense* (Piper) Stapf), millet forage (Pearl millet, *Pennisetum typhoides* (Burm.) Stapf and Hubb.) and veldt grass mainly *Urochloa mosambicensis* (Hack.) as basal diet (60%). Water was provided individually to all the animals on ad lib. basis. Daily intakes of feed and water were recorded and weighing of the animals was done every two weeks. The collected data were analysed statistically for differences. Average daily weight gain by Tswana sheep was significantly different ($p < 0.05$), sheep fed on millet forage had a higher daily weight gain (120.24 ± 8.91 g) compared with sheep fed on veldt grass (92.86 ± 6.94 g). Treatment effects on daily total DM intake by sheep were significant, the control group (*C. ciliaris* L.) had higher intake (705.77 ± 10.22 g) and those fed on sorghum forage had the least intake (668.10 ± 10.70 g). There was no significant difference ($p > 0.05$) in the average daily weight gain by Tswana goats and it was 84.52, 73.81, 83.33 and 78.57 g for goats fed on *C. ciliaris* L., sorghum forage, millet forage and veldt grass respectively. Average daily total DM intake by goats was 655.27, 652.64, 650.07 and 650.94 g for *C. ciliaris* L., sorghum forage, millet forage and veldt grass respectively. Feed conversion efficiency was 8.00, 8.98, 7.93 and 8.34 for goats fed on *C. ciliaris* L., sorghum forage, millet forage and veldt grass respectively and were not significantly different ($p > 0.05$). (*Asian-Aus. J. Anim. Sci.* 2000. Vol. 13, No. 8 : 1127-1132)

Key Words : Tswana Sheep and Goats, *Lablab purpureus* L., *Cenchrus ciliaris* L., Sorghum Forage, Millet Forage and Veldt Grass

INTRODUCTION

Sheep and goats are small ruminants distributed widely throughout the geographic and climatic regions of Botswana. Goats adapt quickly and can be productive under almost any condition if they are properly managed. Goats are therefore widely kept than sheep in Botswana. (Aganga and Nsinamwa, 1997). Tswana goat breed was described by Aganga et al. (1996) while the Tswana sheep breed was characterised by Aganga et al. (1997).

Goats are referred to as inquisitive browsers, that is in most cases they prefer to feed on plant leaves and they are highly selective. Sheep feed mostly on grasses and as such are termed grazers. Depending on the forage type that is available on the rangelands the feeding habits of these small ruminants can be altered, that is sheep can browse and similarly goats can also graze.

Production of forage and fodder by farmers can be

carried out in order to feed or supplement the daily feed intake of livestock. The fodder crops can be grown for stall feeding, grazing or conserved as hay or silage for use in the deficit periods. The forage plants that can be grown include sorghum forage, millet forage, *Lablab purpureus* L. and *Cenchrus ciliaris* L.

Cenchrus ciliaris L. (Buffel grass) is a tufted, perennial shrub with culms up to 1 m tall, often it is geniculate and branched. Common in warm and dry parts, but also widespread in other regions. The grass grows on all soil types, but does well on sandy, limy and stony soils. Generally the grass is palatable with high leaf production. *Cenchrus ciliaris* L. is suitable for hay and it becomes hard and fibrous in winter and late in the growing season. Mostly it has a high grazing value (Van Oudtshoorn, 1991).

Lablab purpureus L. is a proteinaceous roughage. It is a climbing erect annual or short-lived perennial legume reaching a height of 1 m. It has stems in climbing types and has trifoliate leaves. Depending on the subspecies, it bears large pods of different size and shape. The crop is resistant to drought and will grow in areas with less than 500 mm annual rainfall,

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adapted to warm humid regions. It is not tolerant to waterlogging, but will withstand frost and grows on a wide variety of soils. (Heath et al., 1985).

Sorghum forage (Sudan grass) (*Sorghum sudanense* (Piper) Stapf.) is an annual crop without rhizomes and can reach a height of 2.5 m. It is characterised by thin stems, numerous rather broad leaves and many tillers. Sudan grass has a useful carrying capacity and it should not be pastured until the plants are 45 cm to 60 cm tall, to ensure that there is no risk from prussic acid poisoning. At this height the protein content will be between 10-13 percent, while fibre content is about 25 percent. During hay making the leaves tend to dry quickly while stems take longer to dry. (Dogget, 1970).

Pearl millet (*Pennisetum typhoides* (Burm.) Stapf and Hubb.) is an erect annual grass which reaches heights of 2-5 m. The crop has long, pointed leaf blades with finely-serrated margins, and stems are pithy. Millet forms tillers which occur freely from axillary meristems borne at each node. The tillers may occur from nodes 20 cm or more above ground level in some cultivars. Pearl millet is seldom made into hay, although sometimes other millets are grown in mixture with soybeans for this purpose. Greatest forage DM yields from pearl millet and sorghum are obtained as the plants approach maturity or attain heights of 80-120 cm. Despite the high DM, mature plants of such heights are not suitable for grazing. The recommended heights for uniform grazing and least waste are 50-70 cm. To obtain best regrowth grazing should be suspended when 10-15 cm of growth and some succulent plant parts with buds are left (Heath et al., 1985).

Veldt grass mainly *Urochloa mosambicensis* (Hack.) refers to the native vegetation used mostly for grazing. Veldt grass is composed of a number of grass species in a particular area. The mixture of good and poor grass species at different ratios implies that the nutritive value and utilization of veldt grass by livestock differs according to the species present in a particular location.

The present study was designed to investigate the efficiency of Tswana sheep and goats in utilizing buffel grass, sorghum forage, millet forage, veldt grass as basal diet when *Lablab purpureus* L. was fed as the main protein source.

MATERIALS AND METHOD

Housing and feeding

Forty yearling Tswana sheep and goats (20 sheep and 20 goats) of both sexes were used in the project which was conducted at B.C.A. Content Farm in Gaborone for a period of ninety (90) days. The sheep and goats were dipped against ecto-parasites,

dewormed against internal parasites and weighed. The animals were randomized into four treatment groups of five animals per species balancing for weight and sex such that average initial weights were not statistically different.

The animals were individually housed under a common roof in pens of 1.5 m × 1 m with concrete floors and half walls that allowed for free ventilation. They were individually fed in their pens on *ad lib.* basis.

All the animals were given the diet constituting 40% *lablab purpureus* L. as a protein supplement. In addition to *L. purpureus* L. the control groups of both species were fed on 60% *C. ciliaris* L. as basal diet. The other three treatment groups of both species were fed on different forages namely; sorghum forage, millet forage and veldt grass as basal diets on dry matter basis. Water was provided individually in the pens on *ad lib.* basis.

The pens were cleaned and left overs of feeds and water weighed daily in the mornings before providing the day's ration. The volume of water given and left was obtained by the use of a measuring cylinder, while the feeds given and left overs were measured using a platform electronic scale. An Avery walk-in scale was used to weigh the animals every two weeks and the weighing was done in the mornings before feeding.

Feedstuff analysis

Representative samples were obtained from the bales of hay forages and collected in sampling bags. The feed samples were weighed before being placed in the oven at 105°C for 24 hours. The oven dried samples were weighed to obtain DM content.

The samples were ground using a laboratory hammer mill and were labelled and stored in bags.

Crude protein (CP) was obtained by determining the nitrogen using the Kjeldahl method AOAC (1995) and % N multiplied by 6.25 to get the % CP.

Ash content of the feeds was determined according to Kjeldahl method AOAC (1995) in which the samples were weighed and placed in the muffle furnace at 550°C for 2 hours and the remaining ash weighed.

The flame photometer and atomic spectrometer were used in the determination of minerals.

Fibre constituents (NDF, ADF, and ADL) and *in vitro* true digestibility (IVTD) were determined using the procedures and equipment by Ankom (1997).

Gross Energy (GE) was determined using bomb calorimeter by SANYO Gallenkamp (1997) procedures.

Statistical analysis

The data collected was analysed statistically using ANOVA and Duncan's new Multiple Range Test

Table 1. DM content (%), chemical composition (%), and GE of feeds fed to sheep and goats

	<i>Lablab purpureus</i> L.	Sorghum forage	Millet forage	Veldt grass	<i>Cenchrus ciliaris</i> L.
DM	91.36	91.20	88.64	91.83	93.90
CP	16.4	6.39	5.50	9.29	4.88
ADF	31.80	35.87	32.60	25.27	43.60
NDF	42.40	58.20	55.67	36.27	71.00
ADL	4.74	4.83	4.22	3.30	6.47
IVTD	75.80	68.40	73.20	78.00	59.60
Ash	10.84	11.19	10.56	10.22	7.74
GE (kcal/g)	4.08	4.13	4.12	4.46	4.12

Table 2. Mineral composition of forages (DM basis)

Feed	Macro minerals (%)					Micro minerals (ppm)			
	Ca	P	Mg	Na	K	Cu	Fe	Mn	Zn
<i>Lablab purpureus</i> L.	0.96	0.24	0.17	0.11	3.06	20.0	622.5	69.0	27.5
Sorghum forage	0.12	0.21	0.06	0.21	2.19	11.5	658.5	4.5	15.0
Millet forage	0.20	0.13	0.19	0.65	3.46	6.5	264.0	66.5	14.0
Veldt grass	0.55	0.23	0.19	0.11	1.70	11.5	872.5	97.5	16.5
<i>Cenchrus ciliaris</i> L.	0.43	0.18	0.19	0.04	0.82	2.0	387.5	100.5	10.0

(DMRT) using SAS (1990) package.

RESULTS AND DISCUSSION

From table 1, the DM contents of all the forages were high and this was because the feeds were fed as hay. *C. ciliaris* L. had the highest DM (93.90%) while millet forage had the least DM content (88.64%). *Lablab purpureus* L. as a leguminous crop had a higher CP content as compared to the forages. The CP for the forages was within the same range, however CP for veldt grass was slightly high 9.29%, followed by sorghum forage and *C. ciliaris* L. had the least CP content of 4.88%. The capacity of a forage to promote animal production (its feeding value) depends on the chemical composition of nutrients and the amount of forage the animal eat (its voluntary intake). The chemical characteristics of forages (for example IVTD, ash, GE, macro and micro minerals) are influenced by the rate of growth of each grass species and the proportion of cell wall constituents to cell contents. All the grasses fed in this study were in the form of mature hay therefore, differences in composition (tables 1 and 2) were mainly due to differences in forage species and variety since the grasses were from the same environment and similar previous sward management. This is in line with the findings of Firdous and Gilani (1999) who observed differences in composition of whole plant samples of maize cultivars. They stated that the cultivars had some effects on chemical composition of all plant fraction but maturity had a much greater effect on concentration of all the structural components.

ADF contents of sorghum forage, millet forage and *L. purpureus* were within the same range with sorghum having the highest (35.87%), followed by millet forage with 32.60%. The highest ADF was in *C. ciliaris* (43.60%) and veldt grass was the least with 25.27% ADF. *C. ciliaris* L. had a higher NDF content (71.00%) while sorghum and millet forages had NDF content within the same range, veldt grass was the least in NDF content (36.27%) as compared to all the feeds.

The ADL contents of all the feeds were within the same range with *C. ciliaris* L. having the high content (6.47%) and the least was veldt grass (3.30% ADL). IVTD was high in veldt grass (78.0%) and lower in *C. ciliaris* L. (59.6%). There was a slight difference in the IVTD percentage of sorghum forage, millet forage and *L. purpureus* L. with sorghum forage being the least of the three. The total mineral content (ash) was lower in *C. ciliaris* L. (7.74%) while the other feeds had the ash content within the same range, sorghum forage having a higher content (11.19%). Veldt grass had a high GE (4.46 kcal/g) followed by sorghum forage and *L. purpureus* L. was the least (4.08 kcal/g), but the GE of the feeds was within the same range. Efficient utilization of nutrients depends on an adequate supply of energy.

Table 2, shows the macro and micro mineral composition of the forages on dry matter basis. The calcium content was high in *L. purpureus* (0.96%), and sorghum forage showed the least calcium content (0.12%) while millet forage was slightly higher than sorghum forage. Millet forage had the least phosphorus composition (0.13%) and *L. purpureus* L. was high in

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

Parameters	Control	Treatment 1	Treatment 2	Treatment 3
	<i>L. purpureus</i> + <i>C. ciliaris</i>	<i>L. purpureus</i> +sorghum forage	<i>L. purpureus</i> +millet forage	<i>L. purpureus</i> +veldt grass
Initial body weight (kg)	19.00 ± 1.00	19.20 ± 1.39	18.60 ± 1.36	19.40 ± 1.29
Final body weight (kg)	27.80 ± 1.16	28.80 ± 1.32	28.70 ± 1.64	27.20 ± 1.16
Body weight gained (kg)	8.80 ± 0.02 ^{ab}	9.60 ± 0.40 ^a	10.10 ± 0.75 ^a	7.80 ± 0.58 ^b
Average daily body weight gained (g)	104.76 ± 2.38 ^{ab}	114.28 ± 4.76 ^a	120.24 ± 8.91 ^a	92.86 ± 6.94 ^b
Average daily DM grass intake (g)	384.52 ± 7.86 ^a	344.56 ± 8.71 ^b	346.61 ± 7.75 ^b	369.30 ± 6.97 ^a
Average daily DM <i>L. purpureus</i> intake (g)	322.54 ± 3.58	323.95 ± 2.47	324.06 ± 2.42	324.04 ± 2.53
Average daily total DM feed intake (g)	705.77 ± 10.22 ^{ab}	668.10 ± 10.70 ^b	670.60 ± 9.66 ^b	693.34 ± 9.12 ^{ab}
Average daily water intake (l)	1.41 ± 0.02	1.40 ± 0.03	1.40 ± 0.02	1.38 ± 0.02
Feed conversion DM/gain (g/g)	6.77 ± 0.16 ^{ab}	5.88 ± 0.23 ^b	5.68 ± 0.36 ^b	7.65 ± 0.63 ^a

^{ab} Means in the same row having different superscripts are significantly different ($p < 0.05$).

± (SE) Standard error.

phosphorus (0.24%). The magnesium composition in sorghum forage was the least (0.06%) and veldt grass, millet forage and *C. ciliaris* L. had a high magnesium content 0.19% each. The sodium content was higher in millet forage (0.65%) and *C. ciliaris* L. showed the least Na content (0.04%). Millet forage also showed a higher potassium content (3.46%), while *C. ciliaris* L. had the least (0.82%).

The micro minerals analysed in the feeds are Cu, Fe, Mn, and Zn. *L. purpureus* L. had a high copper (20.0 ppm) concentration while *C. ciliaris* L. had the least (2.0 ppm). Veldt grass showed a high iron concentration of 872.5 ppm, and millet forage was lower having 264.0 ppm of iron. The manganese content was too low in sorghum forage (4.5 ppm) while *C. ciliaris* L. had a higher content of 100.5 ppm. Zinc concentration was within the same range for sorghum forage, millet forage and veldt grass, *L. purpureus* L. was high (27.5 ppm) and *C. ciliaris* L. had the least Zn concentration of 10.0 ppm. Table 2, shows the macro and micro mineral composition of the forages on dry matter basis. The calcium content was high in *L. purpureus* L. (0.96%), and sorghum forage showed the least calcium content (0.12%) while millet forage was slightly higher than sorghum forage. Millet forage had the least phosphorus composition (0.13%) and *L. purpureus* L. was high in phosphorus (0.24%). The magnesium composition in sorghum forage was the least (0.06%) and veldt grass, millet forage, and *C. ciliaris* L. had a high magnesium content 0.19% each. The sodium content was higher in millet forage (0.65%) and *C. ciliaris* L. showed the least Na content (0.04%). Millet forage also showed a higher potassium content (3.46%), while *C. ciliaris* had the least (0.82%).

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The daily DM intakes of sorghum forage and millet forage by sheep were significantly ($p < 0.05$) lower than the intakes of veldt grass and *C. ciliaris* L. (table 3). The intakes between sorghum and millet forages were not significant ($p > 0.05$), and similarly no significance occurred between the intakes of veldt grass and *C. ciliaris* L. A feed high in NDF usually has low voluntary intake as it occupies a large volume in the rumen. NDF concentration is used as an index of gut fill to predict voluntary feed intake. Despite the high NDF in *C. ciliaris* L. its voluntary intake by sheep was higher than of the other forages. ADF comprises of hemicellulose and lignocellulose and it is used as an indicator of forage digestibility.

In Vitro True Digestibility (IVTD) was low in *C. ciliaris* L. (table 1) and this can be attributed to the high NDF, ADF and ADL concentrations.

Treatment effects on daily DM total feed intake by sheep were significant ($p < 0.05$), the control (*C. ciliaris* L.) intake was significantly higher than the sorghum forage and millet forage intakes. This could be due to the differences in the texture of the grasses. Sorghum forage has a rough and coarse texture compared to the texture of *Cenchrus ciliaris* L. The differences in the physical characteristics of the grasses might have influenced the voluntary intake of the animals. The DM intakes of veldt grass, sorghum forage and millet forage were not significant ($p > 0.05$). There was no significant difference in the daily legume (*L. purpureus*

Table 4. Intake and response of Tswana goats during experimental period

Parameter	Control	Treatment	Treatment 2	Treatment 3
	<i>L. purpureus</i> + <i>C. ciliaris</i>	<i>L. purpureus</i> +Sorghum forage	<i>L. purpureus</i> +Millet forage	<i>L. purpureus</i> +Veldt grass
Initial body weight (Kg)	18.60 ± 1.08	18.80 ± 1.83	16.00 ± 1.00	16.40 ± 0.24
Final body weight (Kg)	25.70 ± 0.86	25.00 ± 1.48	23.00 ± 0.63	23.00 ± 0.37
Body weight gained (Kg)	7.10 ± 0.64	6.20 ± 0.37	7.00 ± 0.45	6.60 ± 0.24
Average daily body weight gained (g)	84.52 ± 7.62	73.81 ± 4.45	83.33 ± 5.52	78.57 ± 2.91
Average daily DM grass intake (g)	333.27 ± 5.38	329.82 ± 7.46	338.46 ± 11.31	328.84 ± 6.65
Average daily DM <i>L. purpureus</i> intake(g)	321.11 ± 1.87	322.78 ± 2.16	323.88 ± 2.65	322.13 ± 2.13
Average daily total DM feed intake (g)	655.27 ± 7.28	652.64 ± 9.22	650.07 ± 9.27	650.94 ± 8.51
Average daily water intake (l)	1.25 ± 0.02 ^b	1.26 ± 0.02 ^b	1.33 ± 0.02 ^a	1.26 ± 0.02 ^b
Feed conversion DM/gain (g/g)	8.00 ± 0.71	8.98 ± 0.57	7.93 ± 0.51	8.34 ± 0.35

^{a,b} Means in the same row having different superscripts are significantly different ($p < 0.05$).

± (SE) Standard error.

L.) intake by sheep in all the treatments.

Average daily body weight gain was significantly different ($p < 0.05$). The sheep fed on sorghum forage, millet forage had a higher daily weight gain than those fed on veldt grass. The sheep in the control group, however did not have a significant difference ($p > 0.05$) with all the treatment groups. The sheep on millet forage had a higher daily weight gain of 120.24 ± 8.91 g as well as body weight gained (10.10 ± 0.75 kg).

The treatment effects on daily water intakes by sheep were not significant ($p > 0.05$), but the sheep fed on *C. ciliaris* L. had a slightly high intake (1.41 l) and the least water intake was observed in those fed veldt grass (1.38 l). There was a significant difference ($p < 0.05$) in feed conversion efficiency by sheep fed on millet forage having a lower ratio (5.68 ± 0.36) and those fed on veldt grass having a high ratio (7.65 ± 0.63). The sheep fed on millet forage, sorghum forage, and *C. ciliaris* L., however, had no significant difference ($p > 0.05$) in the feed conversion efficiency. Sheep fed on millet forage were found to be more efficient as having the least feed conversion efficiency ratio.

The results in table 4, indicated that there was no significant difference ($p > 0.05$) on the daily DM grass intake, daily DM *L. purpureus* L. intake and daily DM total feed intake by goats. Despite the differences in the chemical composition of the feeds as shown in table 1, the intakes in all the treatment groups were within the same range and this showed that feed intake is not only affected by chemical composition of the feed, but also by other factors such physiological stage of the animal, type of feed.

Daily body weight gain by goats was not significantly different ($p > 0.05$) in all treatments. However, the goats under control had a slightly higher daily weight gain, followed by those fed on millet forage and goats fed on sorghum forage had the least

daily weight gain. The body weight gain was also not significant ($p > 0.05$) in all the treatments. However weight gain was slightly high in the goats fed on *C. ciliaris* L. (7.10 ± 0.64 kg) and the least weight gain was in the goats fed on veldt grass (6.60 ± 0.24 kg). These results are in line with the findings of Makembe and Ndlovu (1995).

There was a significant difference ($p < 0.05$) in the daily water intake, goats fed on millet forage had a significantly high daily water intake (1.33 ± 0.02 l) than those in the other treatments. The daily water intake between the goats fed on *C. ciliaris* L., sorghum forage and veldt grass were not significant ($p > 0.05$), but the intakes of sorghum forage and veldt grass were similar and slightly higher than in the *C. ciliaris* L.

Aganga (1992) stated that the intake of water by sheep and goats depends on climatic conditions, types of feed and physiological state of the animals. Feed conversion efficiency by goats was not significantly different ($p > 0.05$) in all the treatments, but the goats fed on millet forage were slightly more efficient having a lower ratio (7.93 ± 0.51) and those fed on sorghum forage were not as efficient having a higher ratio (8.98 ± 0.57). Goats were found to be equally efficient in conversion of forages and *C. ciliaris* L.

In conclusion, the study showed that Tswana sheep and goats utilized sorghum forage, millet forage and veldt grass as efficiently as they utilize *Cenchrus ciliaris* L. when fed *Lablab purpureus* L. as protein supplement. Consequently we recommend that Tswana sheep and goats could be raised in drylot on these forages to enhance productivity of the animals.

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