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Effects of *Prosopis juliflora* Seedpod Meal Supplement on Weight Gain of Weaner Galla Goats in Kenya

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Abstract: A study was conducted to investigate the effect of increasing amounts of *Prosopis juliflora* seedpod meal on the growth rate of weaner Galla goats. The overall aim of this study was to assess the feasibility of incorporating Prosopis seedpods into a typical dryland livestock production system. Twenty weaner Galla goats of similar age (6 months) and weights (11-14 kg) were randomly assigned to four treatments of five weaners each. The treatments were T_1 No Prosopis (control treatment), T_2 (100 g/goat/day Prosopis), T_3 (200 g/goat/day Prosopis) and T_4 (400 g/goat/day Prosopis). Prosopis contained 88.4% Dry Matter (DM), 18.5% Crude Protein (CP), 83.2% Organic Matter (OM), 51.8% Neutral Detergent Fibre (NDF), 29.8% acid detergent fibre and 5.2% Ash. The experiment lasted for 70 days. Overall, all the treatment groups exhibited higher average weekly weight gains than T_1 (control) throughout the experimental period. However for the first 3 weeks these differences were not statistically significant ($p<0.05$). From the 5th week on wards however, the differences in growth rates were statistically significant ($p<0.05$). Treatment T_3 exhibited highest total weight gain (3.96 kg) followed by T_4 (2.70 kg). Group T_1 had lowest weight by the end of the experiment. This study demonstrated that Prosopis could be used as goats feed up to 200 g/goat/day giving good weight gains and no negative effects on feed intakes and digestibility.

Key words: Growth, feed intake, supplementation, *Prosopis juliflora*, feed conversion, digestibility

INTRODUCTION

Supply of adequate quantity and quality of feed for livestock has been a major challenge throughout the world. Consequently, forage production has been the theme of many studies throughout the world particularly in the dry tropics where this problem is rampant. The constraint of feed supply has led to low livestock productivity in most developing countries. Considering the vast arid and semi arid lands that form most of the rangelands in the tropics, the goats are one of the most adapted livestock species in these areas owing to their adaptive capacity to these environments.

The range goats that are managed under semi-arid climatic conditions mostly rely on a variety of native forages to meet their nutritional requirements. However, these animals face great variability in supply of forage and nutrients throughout the year (Juarez *et al*., 2004). Despite this constraint in the same areas, trees and shrubs are the prominent sources of forage for range ruminants (Bhatta *et al*., 2004) and are mostly utilized as protein supplements in the arid and semi arid lands (Makkar, 2003). This study therefore was geared towards assessing the effectiveness and benefits of supplementing goats with Prosopis seedpod which is widely distributed in Kenya and the fact that it has not been fully utilized as livestock feed due to scant research information regarding to its potential as livestock feed in arid and semi arid areas. Prosopis has a high potential for providing quality forage to livestock in Kenya owing to its high nutritive value of the pods and leaves all the year round. It also grows in the arid and semi-arid areas which are characterized by low (<100 mm) and erratic rainfall.

The overall aim of this study was to assess the feasibility of incorporating Prosopis seedpods into a typical dryland livestock production system. Specifically, the study sought to determine the effect of increasing amounts of Prosopis seedpods on the growth rate of weaner Galla goats. This study further sought to contribute to the inherent problem of inability of natural rangeland grazing systems to supply adequate high quality livestock forage throughout the year to support acceptable livestock growth rates or at least, minimize weight losses. There has been a problem of fluctuations

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in forage supply in the dry and wet seasons in the rangelands. In the latter seasons there is surplus forage and animals are able to meet their nutritional requirements and hence gain weight. This is followed by dry seasons during which animals experience malnutrition from the poor quality and inadequate forage.

MATERIALS AND METHODS

Study area: The study was conducted at Kenya Agricultural Research Institute, Marigat, Perkerra centre, in Baringo district, Kenya.

Experimental animals, design and management: Twenty weaner Galla goats of similar age (6 months), sex (male) and weight (11-14 kg) were randomly assigned to the four treatments resulting in five animals per treatment. They were housed in individual pens of approximately 2.5 m wide and 3.5 m long. The pens were constructed from Prosopis poles. Each cage had a feed and water trough. Prior to bringing all the animals to the pens, they were injected with antibiotic (Adamisine) to minimize stress-induced ailments such as pneumonia. They were also dewormed and sprayed against ectoparasites. The latter was repeated every fortnight and the former after every 4 weeks during the entire study period. The experimental goats were allowed 14 days to adapt to the cages. During this period, they were fed on mixed-species hay obtained locally. They were introduced to their respective treatment diets during the last 3 days of the adaptation period. The experimental duration was 70 days and the animals were weighed every week.

Supplement diets and treatments: The supplemental diet was Prosopis seedpod flour. Hay was the basal diet. The pods were harvested at the ripening stage and stored under cool dry conditions. They were then sun-dried for 3 days and then milled and stored. The pods were ground in a 2-3 mm hammer mill. The treatments were T_1 (Control)-Hay only), T_2 (100 g of Prosopis pod meal per goat per day), T_3 (200 g of Prosopis pod meal per goat per day) and T_4 (400 g of Prosopis pod meal per goat per day). Hay, water and minerals were provided *ad labium*. Feeding was done twice per day at 0800 and 1500 h. In the morning the animals were offered their respective supplements and 1 kg of hay. In the afternoon, they were only offered hay and the amounts were adjusted according their previous day's intake. Daily feed intakes were determined by weighing feed offered and refusals.

Chemical analysis: The proximate constituents of the feed used, faecal samples and minerals were determined using the proximate method (AOAC, 1990) while ADF and NDF were determined using the procedures of Van Soest, 1982. The urine samples were analyzed for nitrogen following the Macro-Kjedahl method (AOAC, 1990).

Statistical analysis: The experimental data on growth performance and feed intakes were analyzed by one-way Analysis Of Variance (ANOVA) (Steel and Torrie, 1980). Where treatment differences were statistically significant, mean separation tests were conducted using Duncan's New Multiple Range Test (Steel and Torrie, 1980) at 5% level of significance.

RESULTS AND DISCUSSION

The average chemical composition of the Prosopis seedpod meal and the hay are shown in Table 1. The dry matter intake (kg day^{-1}) and live weight gains (kg day^{-1}) of the weaner goats are shown in Table 2 while the average weekly weight gains of the goats under different treatments for the 10 week feeding period are shown in Table 3.

Overall, the hay was higher in dry and organic matter but lower in digestibility than the seedpod meal. Notable also is the fact that the pod meal had about 3 times the amount of crude protein.

The two feed components were similar in terms of neutral and acid detergent fiber. However, the hay had about 3 times more lignin than the pod meal. The Prosopis seedpod meal was slightly higher in Ca, P and K

Table 1: The average chemical composition (DM) of *P. juliflora* pod meal and hay

Chemical component	Prosopis seed pods	Hay
DM (%)	88.4±0.3	99.4±0.2
OM (%)	83.2±2.8	90.0±4.6
CP (%)	18.5±0.3	6.1±0.3
ASH (%)	5.2±0.7	9.4±0.7
NDF (%)	51.8±4.2	59.0±5.9
ADF (%)	29.8±0.1	26.8±3.5
ADL (%)	3.2±0.4	8.1±0.5
Ca (%)	0.5±0.1	0.3±0.1
P (%)	0.2±0.1	0.1±0.1
K (%)	0.9±0.1	0.6±0.3
Mg (PPM)	760.0±3.0	917.0±5.5
Fe (PPM)	99.0±2.8	219.0±4.0
Zn (PPM)	1279.0±6.4	1365.0±29.9
Cu (PPM)	40.0±4.0	38.0±2.0
Na (PPM)	51.0±3.0	56.0±3.0

Table 2: Dry matter intake of hay, weight gains and feed conversion ratio

Treatments	Total hay intake (kg)	Total seedpod intake (kg)	Total feed intake (kg)	Total live weight gain (kg)	Feed conversion ratio+
T_1	24.000^a	0.000^a	24.000^a	0.650^a	36.923
T_2	17.200^b	6.800^a	24.000^a	2.250^b	10.666
T_3	17.500^b	13.600^a	31.100^b	3.960^c	7.853
T_4	13.350^c	27.200^a	40.550^c	2.700^d	15.018

Treatment means followed by same superscript within columns are not significantly different ($p<0.05$)

Table 3: Mean weekly live weight gains (kg) of weaner Galla goats on varying amounts of Prosopis seedpod meal

	Weeks								
Treatments	2	3	4	5	6	7	8	9	10
T_1	-0.20^a	-0.20^a	-0.16^a	-0.11^a	0.16^a	0.28^a	0.22^a	0.34^a	0.32^a
T_2	0.14^b	0.20^c	0.06^b	0.24^b	0.18^a	0.38^c	0.36^b	0.37^a	0.36^b
T_3	0.18^c	0.30^d	0.20^c	0.26^b	0.42^b	0.47^d	0.62^c	0.64^c	0.86^d
T_4	0.13^b	0.08^b	0.07^b	0.24^b	0.38^b	0.32^b	0.56^d	0.52^b	0.44^c

Treatment means in the same column with different superscript are significantly different ($p<0.05$)

than the grass hay. Mg, Fe, Zn, Cu and Na were almost similar in the two feed components. Both feed components were notably very high in K but Ca and P were well above the daily requirements for sheep and goats. The mineral contents for Prosopis used in the study were similar to those reported by Abdulrazak *et al.* (2006). They concluded that the CP and mineral concentration of Prosopis forage were satisfactorily high and warrant consideration of its use as supplement to low quality feed.

Treatment group T_1 (no Prosopis pods) had significant ($p<0.05$) effect on dry matter intakes in the four treatments. This group was not supplemented and had to take more DM to meet its nutritional requirements but due to the poor quality hay that was used the weight gains were low. However, treatment T_2 and T_3 had about the same dry matter intakes that were not significantly different ($p<0.05$), despite the differences in treatments.

In vivo dry matter digestibility of Prosopis meal was higher than that of hay, 74.5 and 56.8%, respectively. This can be attributed to the high CP that was present in Prosopis. Animals in T_3 exhibited the highest total hay intake as well as the highest average daily weight gain. These findings are comparable to those of Mahgoub *et al.* (2004) who reported that goats fed 20% Ghaf (*Prosopis cineraria*) had higher feed intakes than those on 30% Ghaf. These high intakes of basal diet (hay) can be attributed to the fact that the Ghaf provided adequate energy: protein ratio which not only increased the essential nutrients to maintain optimal rumen activity but was also more rapidly degraded in the rumen.

Animals in T_4 on the other hand exhibited lower hay intake than the animals in all the other treatments which closely tallied with the findings of Mahgoub *et al.* (2004) where sheep fed on increasing amounts of Ghaf at 0, 15, 30 and 45% demonstrated a sudden drop in feed intake when the amount of Ghaf approached 45%. Horton *et al.* (1993) also observed a drop in feed intake in Omani sheep when the Ghaf level approached 29%. The reduction in feed intakes exhibited by animals on high proportions of Prosopis pods may be largely attributed to the increase in tannin and other phenolic compounds in the diet. Presence of these compounds has been associated with reduced rumen microbial activity. In this study, T_3 animals exhibited the highest feed conversion rate (FCR = 7.853) while T_1 had the lowest conversion rate (FCR = 36.923). Diets with a low FCR are considered to be more economical in animal production. These low FCRs observed in this study can be attributed to the fact that Prosopis contributed the fermentable energy to the rumen in the form of available cellulose and hemicelluloses which stimulate fibre digestion and hence nutrient released for growth (Silva and Orskov, 1985).

Overall, all treatment groups exhibited higher average weight gains than the control group. However, the differences were not statistically different ($p<0.05$) during the first 3 weeks.

However, between the 5-10th week, all the supplemented groups exhibited significantly higher growth rates than the control ($p<0.05$). T_3 had the highest weight gain followed by T_2 and T_4. T_1 had a lower weight gain in all the treatments. These superior performances exhibited by the supplemented goats can be largely attributed to the high CP content of the seedpod meal. The results here demonstrate a direct relationship between the CP content and animal performance. The results also show a positive relationship between the dietary CP content, hay intake and animal performance. The hay intake increased with increase in CP content which in turn improved the growth rate of the goats. The findings of this study were consistent with those of Mahgoub *et al.* (2005) who reported that goats fed 20% Meskit (*P. juliflora*) pods had the highest weight gains whereas those fed 30% had the lowest feed intake. They also reported that the goats fed rations with Rhodes grass hay as a major constituent of the diet had lower feed intake than those fed 10 and 20% Meskit pods, possibly due to relatively higher fiber content.

In this study, the T_4 treatment group depicted the lowest weight gain rate but started losing weight from the 8th week. The weight loss was associated with lower feed intake which in turn was attributed to the high proportion of Prosopis in the diet. As indicated above, the latter may have depressed feed intake due to reduction in palatability associated with the tannins and other phenolic compounds. Mahgoub *et al.* (2005) also observed loss of weight in goats fed on diets with 30% Meskit.

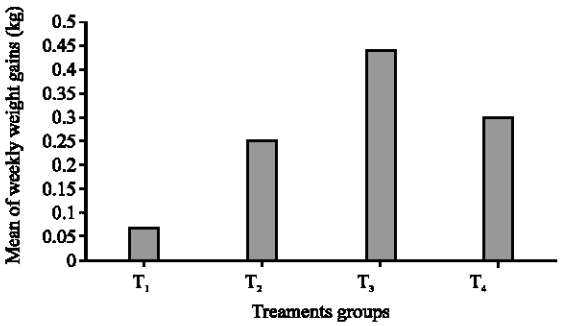

Fig. 1: The mean of weekly weight gains for different treatments

Table 4: Nitrogen budget of goats supplemented with various levels of Prosopis pod meal

Diets	T_1	T_2	T_3	T_4
Ingested N (g day^{-1})	3.2^a	5.4^b	6.7^c	7.2^d
Faecal N loss (g day^{-1})	1.7^a	1.9^b	1.2^c	3.2^d
Urinary N (g day^{-1})	0.9^a	1.2^b	1.0^c	0.6^d
Total N loss (g day^{-1})	2.6^a	4.1^b	4.5^c	5.9^d
Retained N (g day^{-1})	0.6^a	2.3^b	4.5^c	3.4^d
N retained (%)	18.8^a	42.6^b	67.2^c	47.2^b

Treatment means followed by same superscript within rows are not significantly different ($p<0.05$)

Figure 1 shown the mean of weekly weight gains throughout the study period. The T_3 treatment group had the highest mean weight gain rate and hence the best performance. This can be attributed to a combination of high CP and total feed intake. As expected, T_1 had the lowest weekly weight gain. This is attributed to the low total feed intake as well as low CP intake due to lack of supplementation.

Table 4 shown the nitrogen balance status of the animals relative to the different levels of Prosopis seedpod meal in their diets. Fecal N and Urinary N were significantly different ($p<0.05$) among all the treatment groups. The total nitrogen intake increased with the increase in the quantity of the Prosopis seedpod meal in the diets. Treatment T_4 with highest amount of Prosopis pod meal and hence, the highest dietary N content, showed the highest level of Fecal Nitrogen (FN) loss and highest total loss which was significant ($p<0.05$) than the other treatments. The T_1 (control) which was on hay only and hence the lowest dietary N demonstrated the lowest N retention and low total N loss. This outcome is similar to that of Freeman *et al.* (2009) who found that N retention was lower in un-supplemented goats than those that were supplemented.

There was a significant differences ($p<0.05$) in N retained between the supplemented groups and the control (T_1). T_3 had the highest N retention Hence, it was the best performing group in terms of weight gains, followed by T_4 and T_2 which were not significantly different ($p<0.05$). T_1 (control) had the lowest N retention, consequently the poor performance and weight loss at the end of experiment. The superior N retention rate depicted by T_3 can be attributed to efficiency in the utilization of CP ingested due to adequate amounts of hay intake that provided energy needed which boosted the microbial population which in turn increased the digestive activity to the ingesta. A study by Shukla *et al.* (1984) on Kakrei bullocks offered a concentrate ration incorporating 0, 15, 30 and 45% levels of Prosopis pods, reported an increase in live weight gain and positive balances of N, Ca and P up to 30% Prosopis content. However, 40% Prosopis exhibited the lowest intake of hay, despite the high CP intake. Most probably the digestion may have been impaired at this level of Prosopis integration due to the low N retention rate. Shukla *et al.* (1984) also observed that at 45% level of pod feeding, there was a slight negative N and P balance and reduced live weight gain compared to animals at 30% Prosopis seed pod level. As expected, T_1 had low N retention due to poor quality hay (low CP content). Freeman *et al.* (2008) also observed low N retention in goats supplemented with Secondary protein Nutrients (SDN) at increasing proportion and attributed this to decreasing ruminal protein degradability.

CONCLUSION

Prosopis being a native tree that grows in most ASALs of Kenya, it has good properties that enables it grow even in areas with rainfall far much below 100 mm. It has a competitive advantage over many tree species with a high capability of providing livestock with forage during the dry seasons, since it remains green throughout the year. This study demonstrates that Prosopis supplementation gives good weight gains increased intakes, digestibility and feed conversion efficiency. This implies that there is great opportunity in utilizing Prosopis as livestock supplement given that it has no competition with humans for food like many conventional supplements. Goat keeper's farmers should be advised to supplement their goats with Prosopis seedpod meal at optimum level particularly during the dry season. There is also need for further studies on Prosopis supplementation in different livestock species and for longer experimental periods.

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REFERENCES

AOAC, 1990. Official Methods of Analysis. 15th Edn., Association of Official Analytical Chemists, Arlington, VA., USA.

Abdulrazak, S.A., H.K. Juma, R.W. Muinga and M.K. Ambula, 2006. Effects of supplementing maize Stover with clitoria, gliricidia and mucuna on performance of lactating jersey cows in coastal lowland Kenya. Trop. Subtropical Agrpecosyst., 2006: 1-7.

Bhatta, R., A.K. Shinde, D.L. Verma, S.K. Sankhyan and S. Vaithiyanathan, 2004. Effect of supplementation containing polyethylene glycol (PEG)-6000 on intake, rumen fermentation pattern and growth in kids fed foliage of *Prosopis cineraria*. Small Rumin. Res., 52: 45-52.

Freeman, S.R., M.H. Poore, G.B. Huntington and T.F. Middleton, 2008. Evaluation of secondary protein nutrients as a substitute for soybean meal in diets for beef steers and meat goats. J. Anim. Sci., 86: 146-158.

Freeman, S.R., M.H. Poore, G.B. Huntington, T.F. Middleton and P.R. Ferket, 2009. Determination of nitrogen balance in goats fed a meal produced from hydrolyzed spent hen hard tissues. J. Anim. Sci., 87: 1068-1076.

Horton, G.M.J., J.M. Chesworth, A. Srikandakumar, K. Gumaa and J.E. Wohlt, 1993. Nutritional value of *Acacia tortilis* and *Prosopis cineraria* pods for sheep. J. Anim. Sci., 71: 271-271.

Juarez, R.A.S., E.R. Montoya, C.G. Nevarez, S.M.A. Cerrillo and F.L. Mould, 2004. *In situ* degradability of dry matter and neutral-detergent fibre of thorn scrublands forage consumed by goats in the semi-arid region of North Mexico. Anim. Sci., 79: 505-511.

Mahgoub, O., I.T. Kadim, D.S. Al-Ajmi, N.M. Al-Saqry and A.S. Al-Abri *et al*., 2004. Effects of replacing Rhodes grass (*Chloris gayana*) hay with ghaf (*Prosopis cineraria*) pods on performance of Omani native sheep. Trop. Anim. Health Prod., 36: 281-294.

Mahgoub, O., I.T. Kadim, N.E. Forsberg, D.S. Al-Ajmi, N.M. Al-Saqry, A.S. Al-Abri and K. Annamalai, 2005. Evaluation of Meskit (*Prosopis juliflora*) pods as a feed for goats. Anim. Feed Sci. Technol., 121: 319-327.

Makkar, H.P.S., 2003. Effects and fate of tannins in ruminant animals, adapationsto tannins and strategies to overcome detrimental effects of feeding tannin-rich feeds. Small Rumin. Res., 49: 241-256.

Shukla, P.C., P.C. Talpada and M.B. Pande, 1984. Prosopis Juliflora Pods, a New Cattle Feed Source. Animal Nutrition Department, Gujarat Agricultural University, Anand, India.

Silva, A. and E.R. Orskov, 1985. Effect of unmolassed sugar beet pulp on rate of straw degradation in the rumen of sheep given barley straw. Proc. Nutr. Soc. UK., 44: 50-50.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics: A Biometrical Approach. 2nd Edn., McGraw Hill, New York, USA., ISBN-13: 978-0070609259.

Van Soest, P.J., 1982. Refractory and Inhibitory Substances. In: Nutritional Ecology of the Ruminant, Van Soest, P.J. (Ed.). O and B Books, Inc., Corvallis, pp: 118-138.