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Use of Dry Land Tree Species (*Prosopis juliflora*) Seed Pods as Supplement Feed for Goats in the Arid and Semi Arid Lands of Kenya

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Abstract: This study was conducted to determine the potential of incorporating *Prosopis juliflora* seed pods into typical dry land livestock production systems to minimize feed scarcity during the dry seasons and avoiding weight losses and poor performance. The study evaluated supplementation of weaner Galla goats with increasing amounts of *Prosopis juliflora* seedpods that is widely distributed in arid and semi arid areas of Kenya. This species is drought tolerant and with high productivity of seed pods whole year round. The overall aim of this study was therefore, to assess the feasibility of incorporating *P. juliflora* seedpods into a typical dry land livestock production system. The study further sought to find out the optimum supplementation level for improved performance. The experiment involved 20 weaner Galla goats of similar age (6 months) and weights (11-14 kg) which were randomly assigned to four treatments of 5 weaners each. The treatments were No *P. juliflora* (PJP0), 100 g/goat/day *P. juliflora* (PJP100), 200 g/goat/day *P. juliflora* (PJP200), 400 g/goat/day *P. juliflora* (PJP400). Supplementation involved providing the goats with their respective diets in the morning before mixed species range grass hay was offered as basal diet. The animals were weighed on weekly basis and weight gains calculated as difference in previous week's weight and current week's weight. The experiment lasted for 70 days. Overall, all the treatment groups exhibited higher average weekly weight gains than the control group throughout the experimental period. However, for the first 3 weeks, this was not statistically significant ($p<0.05$). From the 5th week up to the 10th week, there was significant difference ($p<0.05$) in the growth rates for the treatments except for the control group. Overall, treatment PJP200 exhibited highest total weight gain (3.960c) followed by PJP400 (2.700 kg). Group PJP0 had the lowest weight gain by the end of the experiment. The supplemented groups showed good weight gains, body condition and retained nitrogen levels compared to the un-supplemented groups.

Key words: Arid and semi arid lands, supplementation, feed conversion efficiency, *Prosopis juliflora*, weight gains, incorporating

INTRODUCTION

P. juliflora (Sw.) DC, hereafter referred to as Prosopis is an evergreen tree endemic to South America, Central America and the Caribbean. It was first introduced to Kenya in 1973 for the rehabilitation of quarries in Mombasa. Later it was introduced to the semi-arid districts of Baringo, Tana river and Turkana districts in the early 1980s (Anderson, 2005).

The tree has been reported by the local communities to be aggressive with a superior competitive advantage compared to the native tree species, resulting to loss of the important plant species that were reliable sources of livestock forage. There are also cases of invasion and allelopathic properties in areas where it was introduced. This loss has also led to loss of biodiversity and encroachment of previously dry season's livestock grazing areas hence, further threatening the livelihoods of the rural poor. Some members of local communities have sued the government seeking compensation for general damages arising from some injuries on their goats which they attribute to consumption of Prosopis such as loss of teeth, poisonous thorns that cause injuries to humans and livestock.

The Invasive Species Specialist Group of the IUCN, rated it as one of the world's top 100 least wanted plant species. Despite these controversies, the tree has promising prospects in the future as livestock feed in Kenya; it grows and flourishes in areas receiving rainfall below 100 mm which many plant species do not. Trees and shrubs in the world, *P. juliflora* being one of them have provided many benefits to man and his animals

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throughout the ages. Their leaves, flowers, pods and tender twigs (browse) have from time immemorial been an important source of wildlife and livestock feed. In many arid and semi-arid lands, this component is sometimes the only source of forage for these animals. Le Houerou (1978) pointed out that nearly one third of the world's land surface is natural grazing land and to varying degrees the shrub-tree component is a crucial source of animal feed. In the same document, analyzing data from various world locations, Le Houerou (1978) found a high dependence of rangeland grazing animals on trees and shrubs to satisfy their protein requirements, especially during the dry seasons. He concluded that without these plants to complement other forage plants, the entire livestock production system would be jeopardized.

The foregoing situation is most likely going to be amplified by the on-going climate change phenomenon. Already, these plants are under serious threat, especially in the Sahelian zone owing to increased periodic droughts and fast growing human and animal populations leading to overexploitation. Other contributing factors include the emerging tendency of previously nomadic or transhumant populations to become sedentary resulting in increased pressure by man and his animals on these plants through expansion of cultivated areas coupled with disappearance of fallows from cultivated areas. In general, although, trees and shrubs are the most visible plant life forms in arid lands, they have been neglected in almost all spheres of scientific research (Mckell, 1974) and land management policies (Le Houerou, 1972).

Motivated by a desire to increase livestock forage, numerous research efforts have been concentrated on methods of shrub eradication or control. The magnitude of these efforts have inclined many students, research workers and land managers towards the myopic view that most if not all shrubs are of low-value and only by converting shrub lands to grasslands can a productive grazing system be created.

This view grossly overlooks the crucial role of trees and shrubs to, not only provide forage but also even-out nutrient supply fluctuations between the dry (dormant) and wet seasons in the dry lands. This prejudiced view towards ligneous plants in general may be attributed to the low appreciation of the tremendous value that they offer to mankind, inadequate knowledge of their biology and potential responsiveness to management. Despite the past and current injustices to trees and shrubs, it is obvious that they are crucial component of all natural pastures throughout the world. In fact, it is inconceivable to visualize natural grazing lands devoid of these plants. Unlike grasses and forbs, ligneous plants, especially the evergreen types, provide livestock with fresh (green) forage during the dry season which is more nutritious than the dead (dry) herbage. They serve as rich sources of proteins, vitamins, energy and minerals at a time when the preferred grasses and forbs are either not available or unable to provide these nutrients. With no supplementation, browse represents at least 20% of livestock diets during the dry season in the Sahelian and northern Sudanian zones. Livestock keepers have from time immemorial utilized these plants to make up for nutritional shortfalls that occur during the dry seasons.

From a strictly pastoral point of view without this vegetation component, there would be no pastoralism as we know it today. The problem hinges around the inability of dry grazing areas to produce adequate high quality livestock forage throughout the year to support acceptable livestock weight gains or at least, avoid weight losses. We argue the solution to this problem may come from prudent utilization of locally available fodder trees and shrubs that come at low cost. Thus, this study aimed to assess the effect of increasing dietary quantities of *Prosopis juliflora* seedpods on the performance of caged Weaner Galla goats in the arid and semi arid areas where goats are one of the most important livestock species due to their hardiness, high reproductive capacity and high quality products like milk, meat and skins.

MATERIALS AND METHODS

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

Experimental animals, supplements and protocol: Total 20 weaner Galla goats of similar age (6 months), sex (male) and weight (11-14 kg) average live weight were used in the experiment. The animals were injected with antibiotic (Adamisine) before being transferred to their cages to minimize stress induced ailments such as pneumonia. The animals were randomly assigned in cages measuring 2.5×3.5 m with a cemented concrete floor.

The cages were made of locally available *Prosopis juliflora* poles and posts each house was assigned a different treatment, making a total of four treatments of five animals each. Each cage had a feeding and water trough. Prior to bringing the animals to the facilities, all the animals were sprayed against ectoparasites. This was repeated after every fortnight. Deworming against endoparasites was done at 4 weeks interval during the study period. The animals were allowed to adapt to the cages for 14 days. During this period, the animals were fed with mixed species hay purchased from Kabarak, Baringo district. However, the animals were progressively introduced to their treatment diets by giving 50 g day^{-1} in the last 3 days of the adaptation period. The experimental period extended for 70 days and the animals being weighed every 7 days. The supplement diet was *Prosopis juliflora* seedpods flour. The seedpods were harvested at the ripening stage during the fruit production season and stored in a cool dry store. They were sun dried for 3 days for easy milling and storage for a longer period. The pods were ground in a 2-3 mm hammer mill to form seedpods meal. The treatments comprised of; Control: No PJP (0PJP), 100 g/goat/day PJP (100PJP), 200 g/goat/day PJP (200PJP), 400 g/goat/day PJP (400PJP). The treatments were randomly assigned to the 4 groups. Hay, water and mineral block were provided *ad libitum* to the animals (Fig. 1).

The animals were fed twice per day at 0800 and 1500 h. At 0800 h, the animals were offered their corresponding supplement diets and 1 kg of hay. At 1500 h the animals received 1-1.5 kg of hay which was adjusted based on the previous day intake.

Data collection and digestibility trial: The animals were weighed on a weekly basis; this was tabulated according to treatments. This was done in the morning after 13 h overnight fast. Average Daily Gains (ADG) were later calculated and recorded. Intake of the hay was determined on daily basis, amount offered was recorded daily and each morning before a fresh hay was offered, feed troughs were cleaned out and orts (refuse) weighed and recorded. The orts were then thoroughly mixed, a sub-sample taken for analysis and the rest discarded. The amount of hay consumed was then determined as the difference between the amount offered and the refuse. When a new batch of hay was brought in, a sample was taken for chemical analysis. *Prosopis juliflora* seedpods meals samples were also taken for nutritional analysis by proximate analysis method. Digestibility trial was evaluated using 3 of the animals assigned to each diet.

During the 8th week, 3 animals per treatment were selected at random and placed in a standard individual crates for metabolic studies. The animals were allowed to adjust to the crates for 7 days followed by 7 days of sample collection. During this trial, a sample of test diet was taken. This was bulked across days and stored for chemical analysis. The total daily faecal output from each animal was collected, weighed and a representative sample (about 10% of daily output) taken. Samples were sundried and packed in plastic bags for chemical analysis. The total 24 h urine output from each animal was collected in plastic containers placed under metabolic crates. About 15 mL of 1M H_2SO_4 was added into the troughs to reduce nitrogen loss through volatization. Daily urine output was measured volumetrically. A sub-sample of 15% (v/v) of the daily output was taken and bulked across the days. The samples were stored on a freezer set at -4°C for nitrogen content analysis. Three animals from the control group were also included in the metabolism study.

Fig. 1: Experimental wearner Galla goats feeding on *Prosopis juliflora* seedpods mea

Body condition scoring procedure: At the end of study period all the experimental animals in each treatment were assessed for body condition and assigned a score. The body condition scoring method used in this study was that by Spahr (2009) which uses a 1-5 ranking where, 1 represents an animal in bad body condition (very thin) and 5 represents an animal in prime body condition (well fleshed). Table 1 shows the body condition scoring indexes used in this method. An average body condition score was calculated for each treatment group as the sum of the scores of each animal in the group, divided by 5.

Chemical analysis: The diet samples and the faeces were oven dried at 60°C for 24 h and then ground through a 1mm Wiley mill during the preparation for chemical analysis. The DM, ash and nitrogen were determined using the procedures of AOAC (1975), procedures described by Goering and Van Soest. Nitrogen and DM determination of the faecal materials was done on wet samples. The urine samples from the freezer were thawed and pooled according to different goats used thoroughly mixed and then analyzed for nitrogen following the Macro-Kjedahl method. Mineral analyses of feed were done according to AOAC (1975) procedures. All the samples were analyzed in duplicates.

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

Chemical component	Prosopis seed pods	Hay
DM (%)	88.4±0.30	99.4±0.2
OM (%)	83.2±2.80	90.0±4.6
CP (%)	18.5±0.30	6.1±0.30
ASH (%)	5.2±0.700	9.4±0.70
NDF (%)	51.8±4.20	59.0±5.9
ADF (%)	29.8±0.10	26.8±3.5
ADL (%)	3.2±0.400	8.1±0.50
Ca (%)	0.5±0.100	0.3±0.10
P (%)	0.2±0.100	0.1±0.10
K (%)	0.9±0.100	0.6±0.30
Mg (PPM)	760±3.00	917±5.5
Fe (PPM)	99±2.800	219±4.0
Zn (PPM)	1279±6.4	1365±29.9
Cu (PPM)	40±4.000	38±2.00
Na (PPM)	51±3.000	56±3.00

Statistical analyses: The experimental data on growth performance and feed intakes of the feed rations was analyzed by one-way Analysis Of Variance (ANOVA) (Steel and Torrie, 1980). Mean separation was done 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. Hay was higher in dry and organic matter. Prosopis 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 three times more lignin than the pod meal. The Prosopis seedpod meal was slightly higher in Ca, P and K 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 dry matter intake (kg) and live weight gains (kg) of the weaner Galla goats are shown in Table 2. Treatment group PJP0 (no Prosopis pods) had significant ($p<0.05$) effect on dry matter intakes in the 4 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 PJP100 and PJP200 had about the same dry matter intakes that were not significantly different ($p<0.05$), despite the differences in treatments.

Live weight gains: The weekly weight gains of the goats under different treatments for a 10 week feeding period are shown in the Fig. 2. Overall all the treatment groups exhibited higher average weight gains than the control group. During the first 3 weeks there was no significant difference between the treatment groups in terms of weight gain ($p<0.05$). However, from the 5th week up to the tenth week, all the treatment groups exhibited significantly higher growth rates than the control ($p<0.05$). Figure 3 shows the mean of weekly weight gains throughout the study period. The PJP200 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, PJP0 treatment 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.

***In vivo* dry matter digestibility of the diets:** Table 3 shows the *in vivo* digestibility coefficients of DM, CP, ash, NDF, ADF and ADL. Except for ADL all the other nutrients showed a general increase in digestibility with increase in *P. juliflora* seedpod meal. Diet PJP0 with no *P. juliflora* seedpod meal supplement, gave significantly ($p<0.05$) lower DM, ash, NDF and ADF digestibility than other the diets. The *in sacco* dry matter digestibility of Prosopis seedpod 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 *P. juliflora*.

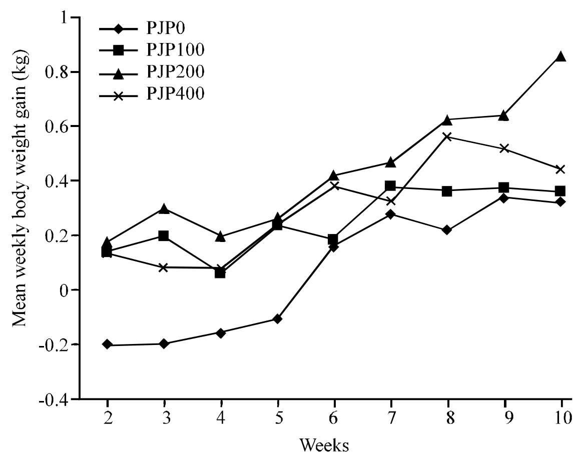

Fig. 2: Mean weekly live weight gain of the goats on increasing amounts of Prosopis seeded meal

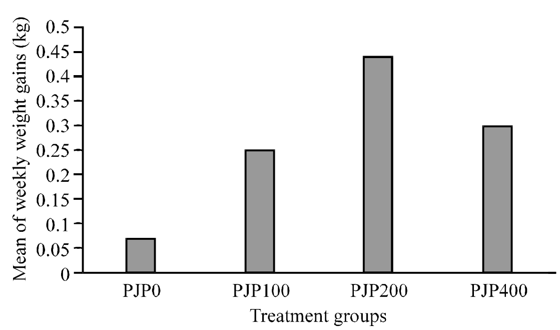

Fig. 3: The mean of weekly weight gains for different treatment

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

Treatments	Total hay intake (kg)	Total seedpod e intake (kg)	Total feed intake (kg)	Total live weight gain (kg)	Feed conversion ratio+
0PJP	24.000^{a}	0.000^{a}	24.000^{a}	0.650^{a}	36.923
100PJP	17.200^{b}	6.800^{a}	24.000^{a}	2.250^{b}	10.666
200PJP	17.500^{b}	13.600^{a}	31.100^{b}	3.960^{c}	7.853
400PJP	13.350^{c}	27.200^{a}	40.550^{c}	2.700^{d}	15.018

+kg feed: kg Gain, *PJP0-no Prosopis, PJP100-100 g/goat/day, PJP200-200 g/goat/day, PJP400-400 g/goat/day; Treatment means followed by same superscript within columns are not significantly different ($p<0.05$)

Table 3: Apparent *in vivo* digestibility (% DM) of diets

Treatments	DM	ASH	CP	NDF	ADF	ADL
PJP0	62.9[a]	24.2[a]	41.2[a]	61.6[a]	51.6[a]	31.4[a]
PJP100	68.3[b]	34.6[b]	64.3[b]	63.3[b]	59.1[b]	28.2[b]
PJP200	73.2[c]	42.1[c]	72.3[c]	71.8[c]	66.2[c]	25.3[c]
PJP400	75.4[c]	44.8[d]	74.5[d]	71.2[c]	70.3[d]	32.1[d]

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

Table 4: Nitrogen budget of goats supplemented with various levels of *Prosopis juliflora* pods

Diets	PJP0	PJP100	PJP200	PJP400
W_{kg} (Ave.weight of goats)	11.8[a]	14.6[b]	17.6[c]	14.4[b]
Ingested N g day^{-1}	3.2[a]	5.4[b]	6.7[c]	7.2[d]
gkg^{-1} $W^{0.75}$ day^{-1}	0.4[a]	0.5[b]	0.5[b]	0.6[b]
Faecal N g day^{-1}	1.7[a]	1.9[b]	1.2[c]	3.2[d]
gkg^{-1} $W^{0.75}$ day^{-1}	0.2[a]	0.2[a]	0.1[b]	0.3[a]
Urinary N g day^{-1}	0.9[a]	1.2[b]	1.0[c]	0.6[d]
gkg^{-1} $W^{0.75}$ day^{-1}	0.1[a]	0.2[a]	0.1[a]	0.1[a]
Total N loss g day^{-1}	2.6[a]	4.1[b]	4.5[c]	5.9[d]
gkg^{-1} $W^{0.75}$ day^{-1}	0.3[a]	0.4[b]	0.4[b]	0.5[c]
Retained N g day^{-1}	0.6[a]	2.3[b]	4.5[c]	3.4[d]
gkg^{-1} $W^{0.75}$ day^{-1}	0.1[a]	0.3[b]	0.4[c]	0.3[b]
Retained N as: % of N intake	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); *PJP0-no Prosopis, PJP100-100 g/goat/day, PJP200-200 g/goat/day, PJP400-400 g/goat/day

Table 5: Average body condition score indices of goats according to the treatment groups

Treatments	Body score
PJP0	1
PJP100	2
PJP200	3
PJP400	2

*PJP0-no Prosopis, PJP100-100 g/goat/day, PJP200-200 g/goat/day, PJP400-400 g/goat/day

Nitrogen balance: Table 4 shows the nitrogen balance status of the animals relative to the different levels of *P. juliflora* seedpod meal in their diets. Urinary nitrogen losses were significantly different (p<0.05) for all the treatment groups. There were also significant differences in the nitrogen retained for all the treatment groups.

Body condition scoring of the experimental animals: Table 5 shows the average body condition score indices. The treatment group PJP0 had the lowest body condition score of 1 at the end of the experiment. They were thin and had poor body shape, i.e., easy to feel ribs. Treatment group PJP200 had good body condition score 3, it was smooth and well rounded. Treatment PJP100 and PJP400 had body condition scores 2 which was easy to feel but smooth. The mineral contents for Prosopis used in the study were similar to those reported by Abdulrazak *et al*. (2006) who reported that that the CP and mineral concentration of Prosopis forage were satisfactorily high and warrant consideration of its use as supplement to low quality feed. PJP200 treatment group had the highest total hay intake (17.5 kg) and average weight gain rate (3.96 kg) in supplemented groups. These findings are comparable to those of Mahgoub *et al*. (2004) who reported that goats fed 20% Ghaf (*Prosopis cineraria*) had higher intakes than those on 30% Ghaf. These high intakes of basal diet (hay) can be attributed to the fact that Prosopis 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. It is reported by Orskov and Dolberg (1984) that supplement should be easily digestible byproduct containing cellulose and/or hemicelluloses and this will increase intakes and digestibility. Also, supplementary feeding provides animals with nutrients in amounts and combinations that the pasture is not providing at the time (Anderson, 1978). It is important to ensure the whole diet of the animal including both supplement and normal diet is balanced. The PJP400 treatment group exhibited lower hay intake than all the other treatments (0.196 kg day^{-1}) which also closely matched the findings of Mahgoub *et al*. (2004) where sheep fed on diets with 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 found Omani sheep on diets containing about 29% Ghaf pods had reduced feed intake. The reduction in feed intakes exhibited by animals on high proportion of Prosopis pods may be attributed to the increase of tannins and other phenolic compounds with the increase in proportions of *P. juliflora* pods.

Also, despite the contribution of the essential nutrients, it might have taken much longer to be broken down hence, the lower intakes of the basal diet (hay). Ingested fibre material must be broken down by rumination, microbial fermentation or both to produce particles which are small enough to pass through the reticulo-omasal orifice Blaxter *et al*. (1956). Diets PJP100, PJP200 and PJP400 with incremental levels of *P. juliflora* seedpod meal supplement at 100, 200 and 400 g/goat/day, respectively gave higher DM , CP and NDF digestibility than the control group that was not supplemented. The apparent increase in nutrient digestibility with increasing levels of *P. juliflora* in the diets was attributed to the corresponding increase in CP content of the diets. High protein diets supply adequate nitrogen for rumen microbial growth.

This high rumen microbial population is in turn associated with high rumen fermentation and overall digestibility of the ingesta. Weiss also reported an increase in the digestibility of nutrients with increasing amounts of protein content in the diets of alfafa silage and corn silage in cows. They also found out that increasing Metabolizable Protein (MP) increases nitrogen digestibility. Delcurto demonstrated that DM and NDF digestibility increased with an increase in supplemental crude protein of steer diets. Studies by Sultan have also shown that protein supplementation to low quality diets increases nutrient digestibility. In terms of feed conversion ratio, PJP200 treatment group was the best with a 7.853 ratio. Treatment PJP0 was the poorest with FCR 36.923. Diets with a low FCR are considered to be more economical in animal production and should be positive. These low FCR observed 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 (Orskov and Dolberg, 1984).

These improved animal performance exhibited by the goats in response to addition of Prosopis seedpod meal to their diets can be attributed to the high CP content of the meal. The PJP200 treatment group had the highest average total weight gain 3.96 kg followed by treatment PJP400 and 100PJP with 2.70 and 2.25 kg, respectively. Treatment 0PJP had the lowest weight gain. The results here demonstrate a direct relationship between the CP content and animal performance. The results also show a positive relationship between CP content, the hay intake and animal performance.

The higher the CP content, the higher the hay intake and the higher the growth rate. 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 PJP400 treatment group had the lowest rate of weight gain and eventually lost weight during the 8th week.

This can be attributed to the fact that the treatment group on the other hand had lower feed intake. The higher proportions of the Prosopis pod meal in the diet, most probably may have caused a decrease in feed intake as a result of reduction in palatability. Mahgoub *et al*. (2005) found that goats fed 30% Meskit lost weight by the end of his study.

The total nitrogen intake increased with the increase in the quantity of the Prosopis seedpod meal in the diets. Treatment PJP400 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 PJP0 (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 (PJP0). PJP200 had the highest N retention. Hence, it was the best performing group in terms of weight gains followed by PJP400 and PJP100 which were not significantly different ($p<0.05$). PJP0 (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 PJP200 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, PJP0 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.

Body Condition Scoring (BCS) for PJP200 was better than all the other groups, this was attributed to the high protein retention and superior feed conversion efficiency depicted by the goats in this group. Also all this might have been possible by the balanced protein: energy ratio of the diets they consumed. BCS helps adjust feeding for animals. However, this should be done gradually since, ruminant animals are sensitive and any change greatly affects their rumen micro-organisms (Spahr, 2009). This can result in problems such as diarrhea. Supplementary feeding can be adjusted up or down by using the body condition scores.

Study by Zahraddeen *et al*. (2009) on the factors influencing milk yield of local goats under semi-intensive system in Sudan savannah ecological zone of Nigeria, they found out that body condition scores significantly influenced milk yield and it increased with increase in the doe's body condition score. This study shows that it is a parameter that is important in monitoring productivity of goats. Body condition scoring is one tool producers can easily use to monitor nutritional programs in a cowherd (Manuel and Greg, 2002). This includes the supplementation interventions aimed at improving livestock nutrition. Adjusting the nutritional program to obtain desired body condition at different stages of production is necessary to enhance production efficiency (Manuel and Greg, 2002).

CONCLUSION

The results of this study have shown that there is a benefit in utilizing the widely available trees and shrubs in the dry lands as livestock feed, especially the leguminous species like Prosopis.

This improves on animal nutrition and performance. *P. juliflora* seedpods as a supplement for livestock feed. *P. juliflora* seedpods contained high nutrient contents, having CP 18.5, DM 88.4, OM 83.2, Ash 5.2, ADF 29.8, NDF 51.8 and ADL 3.2% with adequate amount of calcium, phosphorus, iron, magnesium, potassium, zinc and copper.

Therefore, the goat keepers in the dry lands should be advised to supplement their goats with this widely available Prosopis pods in the arid and semi arid lands of Kenya to improve on their weight gains and avoid weight losses during the dry seasons. This is one way of utilizing the tree species that grows in the ASALs and its full potential has not been explored.

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