Chapter 13
Use of *Prosopis juliflora* Seedpod as Livestock Feed Supplement in the Arid and Semi-arid Rangelands of Kenya

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Abstract Trees and shrubs have provided many benefits. Currently these are disappearing in the arid and semi-arid areas of Kenya and affecting the livelihoods of pastoralist depending on livestock production. The climate change will affect it further. The trees and shrubs are under serious threat, especially in the Sahelian zone, owing to increased periodic droughts, rapid increase of population leading to over-exploitation. The aim of the study is to assess the feasibility of incorporating *Prosopis juliflora* 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 PJP0-No *P. juliflora* (control treatment), PJP100- (100 g/goat/day *P. juliflora*), PJP200 (200 g/goat/day *P. juliflora*), and PJP400 (400 g/goat/day *P. juliflora*). The experiment lasted for 70 days. All the treatment groups exhibited higher average weekly weight gains than PJP0 (control) throughout the experimental period. However, for the first 3 weeks, these differences were not statistically significant ($P<0.05$). From the fifth week onwards, however, the differences in growth rates were statistically significant ($P<0.05$). Treatment PJP200 exhibited the highest total weight gain (3.96 kg), followed by PJP400 (2.70 kg). Group PJP0 had lowest weight by the end of the experiment. This study demonstrated that *P. juliflora* 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.

Keywords Prosopis juliflora seedpods • Feed conversion efficiency • Body condition scores • Weight gains • Livestock supplementation

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M. Behnassi et al. (eds.), *Science, Policy and Politics of Modern Agricultural System,*
DOI 10.1007/978-94-007-7957-0_13,

13.1 Introduction

Among the trees and shrubs in the world, *P. juliflora* being one of them, have provided many benefits to human and animals throughout the ages. Their leaves, flowers, pods and tender twigs (browse) have 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 animals. Le Houérou (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 Houérou (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 human and 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 Houérou 1972). Motivated by a desire to increase livestock forage, numerous research efforts have been concentrated on methods of shrub eradication (Cook 1958) or control the spread of the invasive species (Texas Agricultural Experiment Station 1973). 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, a productive grazing system can 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 semiarid 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.

13.2 Materials and Methods

13.2.1 Study Area

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

13.2.2 Experimental Animals, Supplements and Protocol

Twenty weaner Galla goats of similar age (6 months), sex (male) and average live weight (11–14 kg) were used in the experiment (Fig. 13.1).

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 fourteen 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 in the last three 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

Fig. 13.1 Experimental weaner Galla goats feeding on *Prosopis juliflora* seed-pods meal

cool dry store. They were sun dried for three 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; (1) Control: No PJP (0PJP), (2) 100 g/goat/day PJP (100PJP), (3) 200 g/goat/day PJP (200PJP), (4) 400 g/goat/day PJP (400PJP). The treatments were randomly assigned to the four groups. Hay, water and mineral block were provided *ad libitum* to the animals.

13.2.3 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-hours 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.

The animals were fed twice per day, at 0800 (morning) and 1500 h (afternoon). 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.

Digestibility trial was evaluated using three of the animals assigned to each diet. During the eighth week, three 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 seven days followed by seven 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-hour urine output from each animal was collected in plastic containers placed under metabolic crates. A volume of 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.

13.2.4 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 Spahr (2009) method of body condition was used 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), as presented in Table 13.5. 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.

13.2.5 Chemical Analysis

The diet samples and the faeces were oven dried at 60 °C for 24 h and then ground through a 1 mm Wiley mill during the preparation for chemical analysis. The Dry Matter (DM), ash and nitrogen were determined using the procedures of AOAC (1975), while Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF) were determined following the procedures described by (Goering and Van Soest 1970). Nitrogen and DM determination of the faecal materials was completed 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 completed according to (AOAC 1975) procedures. All the samples were analyzed in duplicates.

13.2.6 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.

Table 13.1 The average chemical composition of *P.juliflora* pod meal and hay in Dry matter basis

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±3.0	917±5.5
Fe (ppm)	99±2.8	219±4.0
Zn (ppm)	1,279±6.4	1,365±29.9
Cu (ppm)	40±4.0	38±2.0
Na (ppm)	51±3.0	56±3.0

13.3 Results

The average chemical compositions of the *Prosopis* seedpod meal and the hay are presented in Table 13.1. *Prosopis* pod meal had about three times the amount of crude protein compared to the basal hay diet. The two feed components were similar in terms of neutral and acid detergent fibre. However, 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. The Mg, Fe, Zn, Cu and Na were almost similar in the two feed components. Both feed components were notably supplying K, Ca and P, which 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 presented in Table 13.2. Treatment group PJP0 (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 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.

The weekly *Live Weight Gains* of the goats under different treatments for a 10-week feeding period are presented in the Fig. 13.2. Overall, all the treatment groups exhibited higher average weight gains than the control group. During the first three weeks there was no significant difference between the treatment groups in terms of weight gain ($P<0.05$). However, from the fifth week up to the tenth week, all the treatment groups exhibited significantly higher growth rates than the control ($P<0.05$)

Figure 13.3 presents 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

Table 13.2 Dry matter intake of hay, weight gains and feed conversion ratio

Treatment[a]	Total hay intake (kg)	Total seedpod intake (kg)	Total feed intake (kg)	Total live weight gain (kg)	Feed conversion ratio[b]
0PJP	24.0[c]	0.00[c]	24.0[c]	0.65[c]	36.9
100PJP	17.2[d]	6.80[c]	24.0[c]	2.25[d]	10.6
200PJP	17.5[d]	13.6[c]	31.1[d]	3.96[e]	7.85
400PJP	13.3[e]	27.2[c]	40.5[e]	2.70[f]	15.0

[a] 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 ($P<0.05$)
[b] kg feed: kg Gain

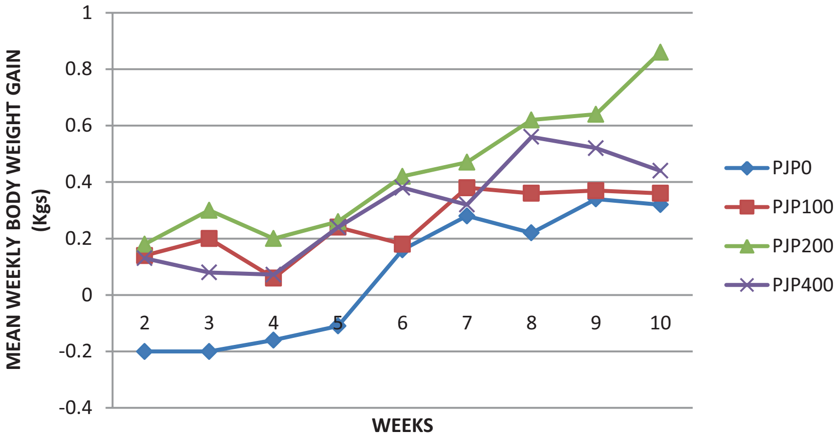

Fig. 13.2 Mean weekly live weight gain of the goats on increasing amounts of *Prosopis* seedpod meal

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.

13.3.1 In Vivo Dry Matter Digestibility of the Diets

Table 13.3 presents the *in vivo* digestibility coefficients of Dry Matter (DM), Crude Protein (CP), Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Acid Detergent Lignin (ADL) and ash. 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

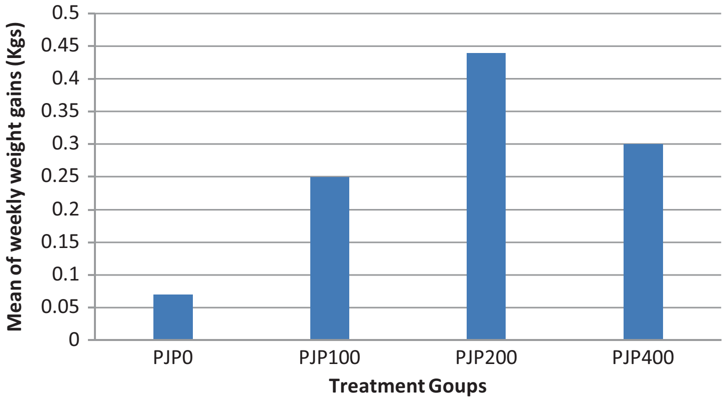

Fig. 13.3 The mean of weekly weight gains for different treatments

Table 13.3 Apparent *in vivo* digestibility (% DM) of diets

Treatment	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 ($P<0.05$)

56.8% respectively. This can be attributed to the high CP that was present in *P. Juliflora.*

Table 13.4 presents 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.

13.3.2 Body Condition Scoring of the Experimental Animals

Table 13.5 presents the average body condition score indices. The treatment group PJP0 had the lowest body condition score of 1 at the end of the experiment. The animals 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.

Table 13.4 Nitrogen budget of goats supplemented with various levels of *Prosopis juliflora* pods

Diets[a]	PJP0	PJP100	PJP200	PJP400
W kg (Av weight of goats)	11.8[b]	14.6[c]	17.6[d]	14.4[c]
Ingested N gd^{-1}	3.2[b]	5.4[c]	6.7[d]	7.2[e]
gkg^{-1} $W^{0.75}$ d^{-1}	0.4[b]	0.5[c]	0.5[c]	0.6[c]
Faecal N gd^{-1}	1.7[b]	1.9[c]	1.2[d]	3.2[e]
gkg^{-1} $W^{0.75}$ d^{-1}	0.2[b]	0.2[b]	0.1[c]	0.3[b]
Urinary N gd^{-1}	0.9[b]	1.2[c]	1.0[d]	0.6[e]
gkg^{-1} $W^{0.75}$ d^{-1}	0.1[b]	0.2[b]	0.1[b]	0.1[b]
Total N loss gd^{-1}	2.6[b]	4.1[c]	4.5[d]	5.9[e]
gkg^{-1} $W^{0.75}$ d^{-1}	0.3[b]	0.4[c]	0.4[c]	0.5[d]
Retained N gd^{-1}	0.6[b]	2.3[c]	4.5[d]	3.4[e]
gkg^{-1} $W^{0.75}$ d^{-1}	0.1[b]	0.3[c]	0.4[d]	0.3[c]
Retained N as: % of N intake	18.8[b]	42.6[c]	67.2[d]	47.2[c]

Treatment means followed by same superscript within rows are not significantly different ($P<0.05$)
[a] PJP0-no *Prosopis*, PJP100–100 g/goat/day, PJP200–200 g/goat/day, PJP400–400 g/goat/day

Table 13.5 Average body condition score indices of goats according to the treatment groups

Treatment[a]	Body Score
PJP0	1
PJP100	2
PJP200	3
PJP400	2

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

13.4 Discussion

The mineral contents for *Prosopis* used in our 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. The 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. (2005) 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 (Ørskov and Dolberg 1984) that, supplement should be easily digestible by-product 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) which also closely matched the findings of Mahgoub et al. (2005) 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, however in this study the tannin levels were not determined, but from literature, the species has been reported to have higher tannin content (Horton et al. 1993). 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 g/goat/day, 200 g/goat/day 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 et al (2009) 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 that increasing metabolizable protein (MP) increases nitrogen digestibility. Delcurto et al. (1990) demonstrated that DM and NDF digestibility increased with an increase in supplemental crude protein of steer diets. Studies by Sultan and Loerch (1992) 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 7.85 ratio. Treatment PJP0 was the poorest with FCR 36.9. 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 (Ørskov 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 kg 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. The 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 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 2000). 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 2000).

13.5 Conclusion and Recommendation

The results of this study have shown that there is a benefit in utilizing the widely available *Prosopis juliflora* species as livestock feed supplement. This improves on animal nutrition and performance. *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 good levels of calcium, phosphorus, iron, magnesium, potassium, zinc and copper required for animal growth and development. 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 semiarid 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.

Acknowledgement The authors would like to acknowledge Kenya Forestry Research Institute (KEFRI) and the University of Nairobi for funding this research. Also the Kenya Agricultural Research Institute (KARI)-Marigat research centre, for hosting and allowing the use of their goats for the experiment.

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