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Article

Effect of feeding tree forages on productive performances on growing sheep

Md. Zillur Rahman, Md.Yousuf Ali[1*], Md. Azharul Islam Talukder[1], Md. Ershaduzzaman and Most. Sumona Akter

[1]Bangladesh Livestock Research Institute, Savar, Dhaka-1341, Bangladesh
[2]Veterinary Surgeon, Central Cattle Breeding and Dairy Farm, Savar, Dhaka-1341, Bangladesh

*Corresponding author: Md. Yousuf Ali, Bangladesh Livestock Research Institute, Savar, Dhaka-1341, Bangladesh. E-mail: 113yousuf.bau@gmail.com

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Abstract: A research work was undertaken to evaluate the feeding effect of tree forages on performance of growing sheep. Twenty growing sheep (in 4 groups) were fed three different tree forage diets. Tree forages *Melia azardirachta, Leucaena leucocephala* and *Artocarpus heterophyllus* were supplied in three treatments except one consisted no tree forages which was considered as control. There were significant ($p<0.05$) differences among the animal groups in terms of total DM and ME intake, although there were no significant differences in the digestibility of DM, OM, CP and ADF. Feeding of tree forages had significant ($p<0.05$) effect on live weight gain of sheep. Animals fed with tree forage based diets significantly increased weight gain (60.70 and 50.70 g/d for *L. leucocephala and A. heterophyllus,* respectively) compared to that (45.66 g/d) of control group fed with silage. Feed conversion efficiency (kg feed/kg gain) also showed that animals fed with tree forage of *L. leucocephala* and *M. azardirachta* based diets were having significantly ($p<0.05$) higher efficiency (11.33 and 11.47, *respectively*) compared to those of *A. heterophyllus* and control diet (13.77 and 13.33, *respectively*). The results of nitrogen balance of *M. azardirachta* and *L. leucocephala* tree forage had significantly ($p<0.05$) positive effect on the nitrogen retention in the body of the animals. Intake of all the tree forages was not similar which indicated that all of them were not accepted to the lamb in same level. So, diets with tree forages of *L. leucocephala* resulted better in terms of weight gain, digestibility and nitrogen balance compared to *A. heterophyllu, M. azardirachta* and silage (control).

Keywords: growing sheep; tree forages; weight gain; digestibility; nitrogen balance

1. Introduction

Livestock feeding management systems in the world is changing in response to population pressure, resource and marketing opportunities. In Bangladesh, the scarcity of green fodder/forages during dry season (winter) is very high. During rainy season a lot of green grasses/forage is grown. Besides, we are able to cultivate more green fodder and surplus fodder/forage during rainy season could be ensiled as silage for feeding sheep. Neem (*Azadirachta indica*) is a useful traditional medicinal plant in Bangladesh.

Each part of the neem tree has some medicinal properties and is commercially exploitable for the development of medicines and industrial by-products. The neem tree has several uses and can be grown under reforestation and social foresting programmes (Ramesh, 2000). It prefers well drained deep soil, sandy loams with ground water at 3.048 metre dept or more. It takes about five years to produce the first fruit crop but can produce a good yield in the third year (Panhwar *et al.*, 2003). The tree has the advantage of growing on marginal lands, where it will not compete with food crops (Sokumbi *et al.*, 2000). Tree legume such as leucaena has great potential as sources of legume fodder, particularly as they are high-yielding perennials and possess deep-rooted systems that may have access to ground water and nutrients that may not be available to smaller leguminous plants (Nguyen Thi Mui *et al*., 2001). The use of jackfruit and other tree and shrub leaves is a common practice for feeding goats in other regions of South East Asia (Dahlanuddin, 2000). Jackfruit plantations are mainly directed to fruit production although it has been estimated that from 20 to 200 kg of green material can be harvested per tree annually (Van Eyes *et al.,* 1986).

Tree forages is used to overcome the feed gaps in many part of the tropic that arise from seasonal fluctuation in the productivity of other feed sources. For example, grasses and other herbs may die when upper soil layers lose their moisture but deep rooted trees exploit moisture at depth and continue to grow. Tree fodders are a cheap source of feed, harvesting and storing being the major inputs, and thus will contribute to sustain smallholder livestock production in rural areas. The leaves of some tree species have potential in increasing growth and feed digestibility in ruminant animals (Alam, 1998). During dry season the inadequacy of fodder/feeds reduced animal productivity. Therefore, the present study was undertaken to evaluate the effect of feeding different tree forages on intake and daily weight change in silage based diet for growing sheep under intensive condition.

2. Materials and Methods

2.1. Site of the experiment

The experiment was conducted at goat and sheep farm, Bangladesh Livestock Research Institute (BLRI). It was continued for a period of 90 days from March 2011 to May 2011.

2.2. Selection, grouping and housing of animals

A total of 20 growing male sheep were used in this study. Age of animals varied from 6 to 8 months. The average initial live weight of the animals was 11.72 ± 1.32 kg. The animals were randomly distributed in four groups each having five animals. The groups were designated as A, B, C and D. The animal grouping was done in such a way that the mean live weight of all the groups was almost similar. The animals were housed in individual pens in animal shed subjected to adequate natural ventilation and sunlight.

2.3. Formulation of diets

Four diets were prepared and considered as four dietary treatments (A, B, C and D) with roughage and concentrates. In the roughage part silage (Jumboo grass) was common to all the treatments, however, three types of tree forages *Melia azardirachta, Leucaena leucocephala* and *Artocarpus heterophyllus* were supplied in three treatments excepting one consisted no tree forages which was considered as control (A). The proportion of silage and tree forages in the ration was 67:33. The concentrate part of the ration consisted of broken maize-30.0%, wheat bran-20.0%, kheshari bran-20.0%, soyabean meal-24.0%, fish meal-2.0%, DCP-2.0%, salt-2.0% and vitamin-0.1%. The concentrate mixture contained of 19% CP and 10.2 MJ/kg DM of ME. Concentrate mixture was fed at 2% of the live weighed. The rations were randomly supplied to different groups of animals.

2.4. Preparation of silage

The grasses were harvested manually. Then the grasses were chopped into 3 to 4 inches in length. About 2.5-3.0 ton fodder can be preserved in 100 cft soil pit. The pit was made in a well-drained and high place. The length was dependent on the amount of grasses. The silage is compact so that no water or air could enter inside the pit. All sides of the pit are covered by polythene.

2.5. Feeding tree forages and silage

Tree forages *Melia azardirachta*, *L. leucocephal* and *A. heterophyllus* were supplied to animal groups B, C and D, respectively. Usually Leaves and edible soft stem parts of the foliage were collected in the afternoon for feeding the animals on the following morning. After harvesting it was chopped with scissor and chop length was 2 to 3 inches then fed to animals. Silage was collected from silo pit in the morning for feeding the sheep on the same day. Concentrate was supplied first followed by roughages with extra 20% of requirements and *adlibitum* access to fresh water.

2.6. Measurement of feed intake and sample collection

The roughage (tree forage and silage) intake of each sheep was determined by subtracting the amount of left over if any from the amount of feed given on the previous day. Refusal was collected every morning before feed supply and weighed to determine daily feed intake. Representative feed samples of tree forages, silage and concentrate mixture were collected for chemical analysis.

2.7. Collection of faeces and urine

For metabolism trial output, faeces and urine were recorded daily during the last 7 days of the feeding trial period of 90 days. Faeces was collected at every 8:00 am and after 24 hours, weighed and sub-sample was taken every day from an animal. Samples of faeces were put in plastic bags in the freezer (-20 °C). Urine sample was collected in a bucket containing 6N H_2SO_4 solution to maintain a pH of 4 or lower and taken 10% sub-sample to determine N.

2.8. Chemical analysis of samples

All the samples of feeds and faeces were prepared and sub-samples were used for analysis. The determination of dry matter (DM), organic matter (OM) and crude protein (CP) was done following the methods of AOAC (1995). The acid detergent fibre (ADF) was determined according to Goering and Van Soest (1970).

2.9. Statistical analysis

The statistical analysis was done using ‘SPSS-11.5’ statistical program to compute analysis of variance (ANOVA) in completely randomized design (Steel and Torrie, 1980). Differences among the treatment means were determined by Duncan′s Multiple range Test (DMRT) (Duncan, 1955).

3. Results and Discussion

3.1. Nutrient composition

Nutrient composition of the diet components used in the trial is shown in Table 1. All the tree forages used in the experiment contained crude protein ranging from 12.83 to 24.70. In the present experiment it was observed that *M. azardirachta* and *L. leucocephala* contained more than twice the CP content of silage. In contrast silage contained lower level of protein (10.92%). Dry matter content of the forages was also higher than that of silage. Crude protein content of concentrate mixture was 19.00%. Theng Kouch *et al.* (2003) observed 36.23% DM, 89.56% OM, 12.81% CP and 10.41% ash in jackfruit leaf which is almost similar to the study, Devendra **(**1982) found 30.00% DM, 22.20% CP and 4.40% ash in *Leucaena* leaves and Bhowmik *et al.* (2008)
Found 34.6% DM, 19.34% CP, 32.00 % ADF and 13.92% ash in neem leaves.

3.2. Feed intake and growth of sheep

Daily intake of feed and nutrients by animals during the experimental period are presented in Table 2. The average total DM intake (g/d) was significantly ($P<0.01$) higher in *L. leucocephala* and *A. heterophyllus* tree forages diet compared to *M. azardirachta* tree forage and non tree forage group. The highest value (g/d) was found in *A. heterophyllus* (698.58 g/d) followed by *L. leucocephala* (687.88 g/d), non tree forage (608.75 g/d) and *M. azardirachta* tree forage (511.43 g/d). The sheep consumed more dry matter when offered tree forages with silages than only silages. This findings agreed by Benavides (1991). Although *M. azardirachta* forages was more nutritious but total DM intake was lower than other diets. This lower intake of DM may be due to less palatability of this forage for sheep. DM intake of concentrate by animals of different treatments was also significant ($p<0.05$). *M. azardirachta* leaves reduced the DM intake of concentrate. Theng Kouch *et al.*(2003) reported that total DM intake was 827 g/d while jackfruit leaves were supplied in trough and highest DM intake (637 g/day) was also observed by Thanh Van *et al.* (2005) in case of jackfruit leaves.

There were significant ($p<0.05$) differences among the dietary treatment groups of animals in terms of live weight gain (Table 2). Live weight gain was significantly ($P<0.05$) higher in *L. leucocephala* diet compared to others. The animals of diet A and B gained (45.6 g/d) and (44.58 g/d), respectively. These were significantly ($P<0.05$) lower live weight gain than other diet C (60.79 g/d) and D (50.7g/d). This decrease is similar to that reported by Dagbir et al. (1980), that bulkiness of neem leaf results in animals not being able to satisfy their energy and protein requirements. Dutta et al. (1986) reported that growth reduction could be attributed to the presence of anti-nutritional factor contained in leaf meals. It appears that different bio-active components of neem leaf may be responsible for depression in nutrient utilization and growth. Improved live weight performance when legumes supplement roughage diets low in N have been reported (van Eys et al. 1986). The relatively faster gains could be attributed to higher ruminal turn-over rate (Thornton and Minson, 1973), more N in the form of amino acids and an increase in total DM intake. Feed conversion efficiency was significantly ($p<0.01$) higher in tree forage groups of *M. azardirachta* and *L. leucocephala* than other groups. Higher CP content of *M. azardirachta* and *L. leucocephala* may be associated with better FCR value. Provision of the quality of protein in the lamb’s diet does not only improve the animal performance but also ensures profitable animal production. These protein sources differ in amino acid profiles which results in varied responses of the animals. Protein source with a higher by-pass value have been reported to have more intense effects on N-balance, growth and muscle mass accretion than those which are lower in by-pass protein. Inclusion of protein sources with amino acid profiles matching closely to the amino acid needs of the growing lambs results in better growth performance and nitrogen utilization by the animal (Khalid *et al.*, 2012).

Table 1. Nutrient composition (%) of feed ingredients.

Ingredients	DM	DM basis (%)			
		OM	CP	ADF	Ash
Melia azardirachta (Hybrid Neem)	27.82	86.59	23.51	25.72	13.41
Leucaena leucocephala (Ipil ipil)	28.91	90.46	24.70	33.72	9.54
Artocarpus heterophyllus (Jack fruit)	37.43	82.81	12.83	40.01	17.19
Silage (Jumboo grass)	23..52	88.49	10.92	46.92	11.51
Concentrate mixture	91.82	90.61	19.00	20.55	9.30

Table 2. Feed intake and live weight gain of growing sheep fed different diets.

Parameters	Dietary treatments				SED	Level of sig.
	A	B	C	D		
Tree forages DM intake (g/d)	-	64.27^{c}	136.90^{b}	147.34^{a}	5.13	**
Silage DMI (g/d)	356.12^{a}	232.18^{c}	273.16^{b}	286.64^{b}	6.72	*
Concentrate DM intake (g/d)	252.62^{a}	214.97^{b}	277.81^{a}	264.58^{a}	3.36	*
Total DM intake (g/d)	608.75^{b}	511.43^{c}	687.88^{a}	698.58^{a}	14.38	*
DM intake (g/kgw $^{0.75}$/d)	85.02^{b}	71.62^{c}	92.71^{a}	96.57^{a}	3.12	*
Estimated ME intake (MJ/d)	4.97^{b}	5.11^{b}	5.77^{a}	5.51^{b}	0.14	*
Initial live weight (kg)	11.75	11.75	11.74	11.71	1.32	NS
Final live weight (kg)	15.86^{bc}	15.76^{bd}	17.21^{ab}	16.28^{b}	0.75	*
Live weight gain (g/d)	45.66^{c}	44.58^{c}	60.70^{a}	50.7^{b}	3.31	*
Feed Conversion Efficiency (kg feed DM/kg gain)	13.33^{b}	11.47^{a}	11.33^{a}	13.77^{b}	0.52	*

^{abc} Mean values in a row with different superscripts differ significantly; NS= Not significant, *P<0.05; **P<0.01; *A= no tree forages (control group), B=Melia azardirachta, C=Leucaena leucocephala, D=Artocarpus heterophyllus*

Table 3. Nutrient digestibility and N balance of animals fed different diets.

Parameters	Dietary treatments				SED	Level of sig.
	A	B	C	D		
DM	72.65	74.65	75.70	74.96	2.87	NS
OM	74.56	77.54	78.43	77.50	2.69	NS
CP	72.56	78.50	77.43	77.27	3.10	NS
ADF	76.45	77.63	78.34	79.43	1.98	NS
N balance						
Nitrogen intake (g/d)	13.54^{b}	17.09^{a}	18.84^{a}	14.23^{b}	1.49	*
Nitrogen out go (g/d)	8.30	8.61	8.96	8.79	1.31	NS
N balance (g/d)	5.58^{b}	9.42^{a}	10.97^{a}	6.00^{b}	1.08	*

*^{abc} Mean values in a row with different superscripts differ significantly; NS= Not significant, *P<0.05; A= no tree forages (control group), B=Melia azardirachta, C=Leucaena leucocephala, D=Artocarpus heterophyllus*

3.3. Digestibility and N balance

These was no significant variation among the dietary groups of animals in case of DM, OM, CP and ADF (p>0.05). Digestibility and intake values for *L. leucocephala* range from 50 to 71% and from 58 to 85 g/kgw$^{0.75}$/d live weight, respectively (Jones, 1979). This value is closer to the present findings. There were significant (p<0.05) differences among the mean values in terms of total N intake (g/d) and nitrogen balance (g/d) but non-significant in case of nitrogen outgo. *L. leucocephala* and *M. azardirachta* group of animals showed significantly (P<0.05) higher values than those of control and *A. heterophyllus* group in case of nitrogen intake and nitrogen balance.

The results of nitrogen balance of the animals clearly showed that *M. azardirachta* and *L. leucocephala* tree forage had significantly (p<0.05) positive effect on the nitrogen retention in the body of the animals. Theng

Kouch *et al.*(2003) found that DM digestibility and OM digestibility were 48.5 and 49.0 %, respectively. DM digestibility of the hanging jackfruit foliage (63.3%) was 14.8 units higher than for the separated leaves, an increase of some 30%. Nguyen Thi Mui (2001) reported that the digestibility of jackfruit foliage was 52.6%, which is in agreement with the values for foliage fed in the trough in our experiment. Theng Kouch *et al.*(2003) reported that nitrogen intake, nitrogen outgo and nitrogen balance were 14.23, 8.79 and 6.00 g/d, respectively in case of jackfruit leaves. Nitrogen intake and faecal and urinary N are determinants of nitrogen balance (N-balance), whereas N intake depends upon DM and CP intake. Feeding high CP diets may also result in greater faecal and urinary N excretion (Fahmy *et al*., 1992).

4. Conclusions

Diets with *L. leucocephala* forages resulted better in terms of weight gain, digestibility and nitrogen balance compared to *A. heterophyllus, M. azardirachta* and sole silage. The diets of sheep may be supplemented with *L. leucocephala* for improved growth performance and further research should be taken on *M. azardirachta* to improve its acceptance to sheep.

Conflict of interest

No one to declare.

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