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Evaluation of Under-utilized Fodder Species for Feeding Small Ruminants in Sri Lanka

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ABSTRACT. Seventeen species of plants commonly fed to goats and sheep were collected and identified. The fodder samples were analyzed for proximate components and cell wall constituents. In vitro dry matter and organic matter digestibility were also determined. The mean dry matter (DM), total ash, ether extract (EE) and crude protein (CP) contents of the fodder leaves were 25.52, 10.44, 3.49 and 15.81%, respectively. Acid detergent fibre (ADF) content varied from 18.37 to 50.08% between fodder species. The mean cellulose and lignin contents were 18.60 and 12.41%, respectively. The mean dry matter digestibility (DMD) and organic matter digestibility (OMD) values were 52.25 and 50.30%, respectively. Despite the higher crude protein and mineral contents, the low digestibility of many of these leaves could be a limiting factor in feeding livestock. A Nitrogen balance trial was conducted using goats for four fodder species viz. Erythrina varigata, Albizia falcataria, Tithonia diversifolia and Artocarpus heterophyllus. Dry matter intakes (DMI) of Erythrina, Albizia, Tithonia and Artocarpus were 46.12, 52.85, 42.08 and 76.74 g/kg $W^{0.75}$, respectively. Positive nitrogen balance was observed in all treatments. The results suggest that these fodders have a good potential for small ruminant feeding.

INTRODUCTION

Goats and sheep are important farm animal species to Sri Lankan economy with a vast potential for improvement. There are many advantages of rearing these small ruminants: they need low capital investment, require less feed, show high reproductive performance, can be managed easily by family labour and can well be fitted into systems where agricultural holding sizes are small.

According to reports, both goats and sheep are mainly distributed in the Dry and Dry Intermediate Zones of the country. Nutrition becomes a major constraint for goat and sheep development in these

areas due to the seasonal pattern of fodder production, resulting from the non uniform rainfall pattern.

Inadequate nutrition of small ruminants cannot be satisfied by using new lands since these lands can be better utilized for cash crop production. Thus, one of the solutions for these limitations is the maximum use of available feed resources together with the adoption of new feeding techniques. Feeding of tender shoots, twigs and leaves of trees and shrubs to goats is a common practice among farmers in Sri Lanka.

The specific objectives of this study were :-

1. To evaluate the nutritive value of some commonly available tree fodders, shrubs and weeds as potential feed resources for small ruminants.

2. To evaluate the utilization of selected species by small ruminants.

MATERIALS AND METHODS

Experiment 1:

Analysis of proximate composition and *in-vitro* digestibility of herbages.

Seventeen species of plants which are commonly used for feeding goats and sheep were collected and identified. The samples consisted of young and mature leaves and tender shoots. They were dried in a unitherm oven at 60 C for 48 hours. The moisture content of each sample was determined. The samples were then ground to pass a 1 mm mesh screen using a laboratory grinder. Ground samples were used for chemical analysis. All samples were analyzed for dry matter, organic matter, total ash and ether extract (A.O.A.C., 1980). Crude protein was determined using Kjeldhal auto analyzer. Acid detergent fibre and acid detergent lignin were analyzed according to Goering and Vansoest (1970). *In-vitro* dry matter and organic matter digestibilities (Tilley and Terry modified 1963) were also determined in all fodder samples using rumen liquor obtained from three fistulated local goats.

Experiment 2:

N balance and intake trial.

This experiment was conducted using sixteen castrated, indigenous, mature, male goats. Animals were grouped into four blocks according to body weights. Four fodder species, namely, *Erythrina varigata*, *Albizia falcataria*, *Tithonia diversifolia* and *Artocarpus heterophyllus* were selected based on their availability and extent of use as a common feed. The treatments were arranged in a randomized complete block design with four replications.

Leaves and tender shoots of these four fodder species were collected in bulk, sun dried and stored loosely in polythene bags. These four treatments were randomly assigned among sixteen goats. The feeding trial consisted 53 days: adaptation period, 17 days; preliminary period, 26 days; collection period 10 days. During the adaptation period, the animals were given the respective test diets and the daily feed intakes were recorded. After the preliminary period, animals were subjected to restricted feeding (10% less full appetite). Feed (100% dried tree fodder) was offered twice a day (from 6.00 to 8.00 hrs and from 16.00 to 18.00 hrs). Feed offered and refused were recorded daily at each feeding. Grab samples of the test diet and refusals were collected. Faeces and urine were collected separately once a day. Urine was collected in plastic buckets containing 15 ml of 10% hydrochloric acid. Urine were stored in the freezer at minus 10 C. Faeces collected from each animal were dried in a unitherm oven at 60 C for 48 hours and their dry weights were taken. Samples of these dried faeces were used for chemical analysis. All animals had free access to clean drinking water. Sub samples were taken from feed, refusals and faeces. They were ground to pass 1 mm mesh screen. The samples were analyzed for DM (AOAC, 1980) and daily dry matter intakes were calculated. Feed, refusals faeces and urine samples were analyzed for nitrogen using Kjeldhal procedure (AOAC, 1975) and nitrogen balance was calculated. The data were statistically analyzed to determine the statistical significance between fodder types and mean separation was done by Duncans Multiple Range Test (Snedecor and Cochran, 1968).

RESULTS AND DISCUSSION

Experiment 1:

The proximate analysis of the shrubs and tree leaves are presented in Table 1. The dry matter content of these fodder varied from 16.9 to 33.08 percent with a mean value of 25.52 percent. Of the 17 fodder species analyzed, 11 species had a dry matter content between 20 to 30 percent while 5 species had over 30 percent.

Table 1. Proximate composition of shrubs and tree leaves (DM basis).

Species	DM	ASH	OM	EE	CP
			%		
1. Albizia falcataria	28.45	06.90	93.10	4.10	19.13
2. Artocarpus heterophyllus	32.59	10.27	89.73	2.88	13.34
3. Azardirachta indica	29.08	07.21	92.79	1.56	13.04
4. Bauhinia racemosa	31.90	08.49	91.51	1.34	14.31
5. Bridelia retusa	22.72	09.34	90.66	4.54	09.14
6. Cassia occidentalis	26.68	11.97	88.03	2.78	19.92
7. Erythrina varigata	21.88	11.27	88.73	5.26	23.64
8. Ficus glomerata	31.62	16.11	83.89	3.13	10.43
9. Gliricidia sepium	22.85	09.27	90.73	4.67	23.17
10. Gymnosporia emarginata	33.08	14.06	85.94	1.63	14.32
11. Leucaena leucocephala	30.25	09.33	90.67	6.33	22.76
12. Manilkara hexandra	24.10	09.90	90.10	4.75	07.98
13. Scichera oleosa	30.00	07.78	92.22	1.59	09.51
14. Spathodia campanulata	25.58	12.25	87.75	2.86	14.75
15. Tamarindus indica	27.29	06.28	93.72	4.92	11.65
16. Thespesia populnea	28.94	10.71	89.29	4.31	17.08
17. Tithonia diversifolia	16.87	16.39	83.61	3.80	24.75
Mean	25.52	10.44	89.56	3.49	15.81

The total ash content varied from 6.90 to 16.40 percent. The mean ash content of the fodder leaves was 10.44 percent. All the fodder tree leaves analyzed in this study recorded high (>10%) or average (5–10%) ash contents. These results indicate that most leaves could be considered as satisfactory sources of minerals. The ether extract contents varied from 1.09 to 5.33% between fodder species with a mean value of 3.49%. The protein contents varied from 7.90 to 24.75% between fodder tree species. The leaves had a mean crude protein

content of 15.81%. Crude protein levels below 8.0% in the dry matter are considered insufficient to meet the maintenance requirements of ruminants and also would effect microbial activity in the rumen (Ibrahim, 1988). Of the 17 plant species, 65% of the leaves recorded a medium crude protein level. The leaves of *Erythrina*, *Gliricidia*, *Leucaena* and *Tithonia* had crude protein levels over 20.0% indicating that these leaves are good sources of protein.

The value for ADF in fodder species were between 18.37 to 50.08% with a mean value of 33.25% (Table 2). Cellulose content of the leaves varied from 11.55 to 24.80 between different fodders, having a mean of 18.60%. Meanwhile, the lignin content varied from 4.70 to 22.00% with an average of 12.41%. Increased lignification may be due to the prominent veins present in these leaves (Chandrasiri *et. al.*, 1987).

Table 2. Cell wall components of shrubs and tree leaves (DM basis).

Species	ADF	Cellulose %	Lignin
1. Albizia falcataria	34.78	18.23	16.05
2. Artocarpus heterophyllus	38.87	22.01	11.18
3. Azardirachta indica	31.73	22.61	08.64
4. Bauhinia racemosa	42.79	24.04	16.49
5. Bridelia retusa	41.34	22.56	16.93
6. Cassia occidentalis	19.41	13.46	04.70
7. Erythrina indica	35.03	23.38	09.23
8. Ficus glomerata	32.58	20.26	08.42
9. Gliricidia sepium	23.19	14.40	08.55
10. Gymnosporia emarginata	18.37	11.55	06.14
11. Leucaena leucocephala	20.59	11.98	08.16
12. Manilkara hexandra	50.08	15.57	21.42
13. Sceichera oleosa	41.60	19.37	22.00
14. Spathodia campanulata	39.72	18.80	16.84
15. Tamarindus indica	31.63	16.41	15.03
16. Thespesia populnia	31.65	24.80	07.67
17. Tithonia diversifolia	32.63	16.85	13.47
Mean	33.25	18.60	12.41

This study suggested very high variation in DMD (27.84 to 72.49%) and OMD (27.15 to 72.98%) as illustrated in Table 3. The mean DMD and OMD values reported were 49.07 and 45.46%, respectively. *In vitro*

organic matter digestibility of 10 species including *Albizia* and *Artocarpus* were less than 45% while that of 4 species including *Erythrina* and *Gliricidia* was more than 55%. The lower IVOMD values were closely related with the higher lignin content (Ibrahim, 1988). Nine plant species had an IVOMD value between 45 to 55%. The low digestibility of most of these fodders could be considered as a limiting factor for feeding livestock.

Table 3. In-vitro digestibility of shrubs and tree leaves.

Species	IVDMD%	IVOMD%
1. Albizia falcataria	36.07	34.78
2. Artocarpus heterophyllus	44.02	44.20
3. Azardirachta indica	54.46	50.82
4. Bauhinia racemosa	33.15	30.62
5. Bridelia retusa	52.75	46.66
6. Cassia occidentalis	71.36	67.45
7. Erythrina varigata	60.70	58.24
8. Ficus glomerata	38.23	39.39
9. Gliricidia sepium	56.26	55.18
10. Gymnosporia emarginata	72.49	72.15
11. Leucaena leucocephala	57.41	54.60
12. Manilkara hexandra	28.05	29.06
13. Scheira oleosa	27.84	28.52
14. Spathodia campanulata	54.80	49.41
15. Tamarindus indica	46.93	44.59
16. Thespesia populnia	44.34	40.56
17. Tithonia diversifolia	55.30	49.13
Mean	49.07	45.46

Experiment 2:

Dry Matter Intake (DMI)

The dry matter intake of goats fed different tree leaves are given in Table 4. The average DMI varied from 395 to 717 g between treatments. The lowest DMI of 2 percent of the body weight (corresponding to 42.08 g/kg $W^{0.75}$) was recorded in goats fed *Tithonia* leaves while the maximum intake of 3.75 percent of the body weight (corresponding to 76.74 g/kg $W^{0.75}$) was recorded in goats fed

Artocarpus leaves. These values are within the reported range (between 1.8 to 3.8 percent of the body weight equivalent to 40.5 g/kg $W^{0.75}$ and 127.3 g/kg body weight $^{0.734}$, respectively) of dry matter intake for goats in the tropics (Hossain, 1960; Ademosum, 1970; Singh *et. al.*, 1974; Uphadhya *et. al.*, 1974; Gihad, 1976; Maheswari and Talapatra, 1975). Significant differences ($P<0.05$) were observed in the daily DMI of goats fed different tree leaves, but when calculated in terms of g/kg metabolic body weight and percent of body weight of animals revealed no significant variation ($P<0.05$) between treatments.

Table 4. Dry matter intake of goats fed tree leaves.

Fodder type	DMI*		
	g/day	g/kg $W^{0.75}$	% body weight
Erythrina	397	46.12	2.27
Albizia	489	52.85	2.52
Tithonia	395	42.08	2.00
Artocarpus	717	76.74	3.75
SEM	71.91	5.49	0.28

* Dry Matter Intake is an average of 8 days of observation.

Nitrogen balance

The results of the nitrogen balance experiment are presented in Table 5. In all the treatments, animals were in a positive balance. The nitrogen retention in g/day was 5.42, 2.09, 5.41 and 3.22 in *Erythrina*, *Albizia*, *Tithonia* and *Artocarpus*, respectively. The differences between the fodders were not statistically significant ($P>0.05$). The positive values for nitrogen retention indicate that the leaves of *Erythrina*, *Albizia*, *Tithonia* and *Artocarpus* can supply sufficient nitrogen to adult male goats. Although the statistical significance was lacking ($P>0.05$), nitrogen

retention tended to be higher in goats fed *Erythrina* and *Tithonia*. This was mainly due to the higher nitrogen intake of goats fed *Tithonia* and *Erythrina*. However, the goats given these two fodder types showed increased nitrogen excretion in urine as compared to the *Albizia* and *Artocarpus* indicating that a larger proportion of the absorbed nitrogen has not been utilized.

Table 5. Nitrogen balance of Goats fed tree leaves.

Item	Treatment				
	Erythrina	Albizia	Tithonia	Artocarpus	SE
Intake, g/d	19.52	14.07	19.51	13.57	±0.84
Excretion, g/d					
Faecal	4.27	9.11	5.87	6.47	±0.59
Urinary	9.83[a]	2.87[b]	8.23[c]	4.28[d]	0.75
Total	14.10	11.98	14.10	10.75	±0.63
Retention, g/d	5.42	2.09	5.41	3.22	±0.45
% of Intake	27.67	16.63	25.53	22.98	±2.16
% of Absorbed	35.45	40.97	39.41	42.69	±3.08

Means in a row with different superscripts are significantly different ($P<0.05$).

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