Nutritional Evaluation of Fodder Tree Leaves with Goats

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ABSTRACT : Two experiments were conducted to evaluate the nutritional value of common fodder tree leaves with goats fed at 50% of total ration. In experiment 1, leaves from six fodder tree species i.e., *Ailanthus aitissima, Elaeagnus angustifolic, Morus alba (Mulberry), Populus spp, Robina pseudoacacia* and *Salix babylonia* were harvested in spring and winter from northern areas of Pakistan. Chemical composition and apparent *in situ* dry matter digestibility (DMD) of fodder tree leaves were measured. Results showed that crude protein (CP) values were higher ($p<0.05$) in all the species during spring compared to winter (17.9% vs 12.0%). The concentration of NDF in Elaeagnus and Robinia was higher in spring, whereas no seasonal difference was found in other species. *In situ* DMD was higher ($p<0.05$) in Ailanthus and Populus at spring while it was higher ($p<0.05$) in Elaeagnus, Mulberry and Robinia at winter. There was no ($p<0.05$) seasonal effect on *in situ* DMD of Salix. In experiment II, four iso-nitrogenous and iso-caloric rations viz., A, B, C and D were prepared containing 50% (winter harvested) sun dried leaves of Salix, Robinia, Mulberry and Elaeagnus, respectively and 50% concentrate. Dry matter and crude protein intakes were higher ($p<0.05$) given ration A (Salix) whereas DM and CP digestibility was lowest ($p<0.05$) given ration B. Nitrogen retention was higher ($p<0.05$) given ration A. Goats fed on fodder tree leaves and concentrate showed moderate intake and digestibility. ***(Asian-Aust. J. Anim. Sci. 2001. Vol 15, No. 1 : 0000-0000)***

Key Words : Tree Leaves, Digestibility, Goats, Composition

INTRODUCTION

Small ruminants, the predominant livestock in alpine pasture of the northern areas in Pakistan, make significant contribution to farmers income under three production systems i.e. 1) nomadic grazing, 2) semi-nomadic grazing and 3) local grazing (Mohammad, 1989). However, the production levels are poor mainly due to TDN and CP deficiencies of 30% and 45%, respectively (Archer, 1994; Khan et al., 1995). The major feed resource is rangeland but during severe winter animals are stall fed on stored crop residues, alfalfa and dry fodder tree leaves. Raghavan (1989) indicated that tree foliage makes a significant contribution to meet the nutritional requirements of the ruminants during the winter. It is well recognised that some tree leaves are palatable, digestible and high in protein (Palmer and Schlink, 1992; Subba et al., 1994; Leng, 1997). Tree leaves have also been successfully incorporated into concentrated supplemented diets of sheep and goats (Bhatia et al., 1976; Parthasarathy, 1986; Rojas and Benavides, 1994). It is apparent that the nutritional value between tree/species leaves varies, but there is no information on the nutritional profile of fodder tree leaves between seasons in northern areas of Pakistan and their use as primary nutrient source in total mixed ration. The present study examines the nutritive value of fodder tree leaves with goats.

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MATERIALS AND METHODS

Two experiments were conducted as follows:

Experiment 1

Collection and preparation of samples : Leaves of six fodder trees i.e., Ailanthus, Elaeagnus, Mulberry, Populus, Robinia and Salix were collected in spring and winter seasons from northern areas of Pakistan. Fresh leaf samples not less than one kilogram were collected from each fodder tree species during each season from different areas. The fresh leaves were cleaned to remove any visible surface contaminants e.g. pest eggs, bird droppings, dust and soil deposits and then weighed. These samples were sun dried and packed in polyethylene bags and brought to Animal Nutrition Laboratory, National Agricultural Research Centre, Islamabad. Sun dried leaves were chopped, dried at 60°C, ground (through 1 mm mesh sieve) and stored at room temperature for subsequent chemical analysis and *in situ* dry matter digestibility (DMD).

Chemical analysis and apparent in situ DMD : Dry matter, crude protein (CP) and total ash (TA) were determined according to AOAC, (1990). Neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) and hemicellulose were determined as described by Van Soest et al. (1991). Apparent *in situ* DMD was determined according to the technique described by Ørskov et al. (1980). Two male goats fitted with permanent rumen cannula were maintained on a forage based maintenance ration to determine *in situ* DMD. Four gram samples of leaves (3 bags/species) were weighed into dacron bags having 52±2 mu^2 pore size with dimension of 18×10 cm. All bags including duplicate empty bags were

simultaneously introduced into the rumen of two cannulated goats for 48 h. After the incubation period, the bags were taken out and gently washed until the rinse water was clean and dried at 60°C. The contents of the bags were weighed and *in situ* DMD was calculated.

Statistical analysis

The effect of two seasons i.e. spring and winter on the nutrient composition and *in situ* DMD was analysed using a t- test (Steel and Torrie, 1980).

Experiment 2

Leaves from Salix, Robinia, Mulberry and Elaeagnus were harvested in winter from northern areas of Pakistan. These fodder tree leaves were sun dried, sacked and brought to the Animal Nutrition Laboratory, Islamabad. Representative samples of leaves were ground to pass through 1 mm mesh sieve and then analysed for proximate contents. Total digestible nutrient (TDN) was calculated from regression equation based on proximate analysis (Wardeh, 1981).

Ration preparation : Four iso-nitrogenous and iso-caloric mixed rations containing 50% sun dried, A (Salix), B (Robinia), C (Mulberry) or D (Elaeagnus) leaves and 50% concentrate mash feed were prepared at the Feed Technology Unit. Concentrate mash feeds contained cottonseed cake, rice polish, molasses, di-calcium phospate and common salt. Nutrient composition of the experimental rations are presented in table 3.

Digestibility and nitrogen balance trial : A digestibility and nitrogen balance trial was conducted in a 4×4 Latin square design involving four mature male betal goats weighing 33±1 kg. During the trial, the goats were placed in individual metabolic cages (L=1.2 m, W=0.76 m and H= 0.9 m elevated by 0.6 m from the ground) having the provision to collect feces and urine separately. Animals were given 15 days to adjust and during this period voluntary dry matter intake (DMI) was recorded. Thereafter, a five days collection period was given at which the goats were fed 90% of their voluntary DMI. Daily feed offered, orts and feces voided were measured, sub sampled, composited and stored at 5°C for subsequent analysis. Urine was collected in plastic bottles containing 50 ml 3 N HCl to prevent nitrogen losses. Daily urine output was measured and immediately analysed for total nitrogen (AOAC, 1990). Representative samples of feed, orts and feces were analysed for DM, CP and CF according to AOAC (1990).

Statistical analysis

Data from the digestibility and nitrogen balance trial using 4×4 Latin square design were analised to test the treatment effect. Duncan's Multiple Range Test was applied to compare the treatment means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Experiment 1

Seasonal nutrient profile of fodder tree leaves : Results of the proximate and detergent fibre analyses of tree leaves (table 1) showed that DM of various tree leaves was higher

Table 1. Seasonal proximate composition and cell wall constituents of various fodder tree leaves (%DM)

Species	DM %	CP	NDF	ADF	Hemi cellulose	ADL	Ash
Salix							
Spring	54.5	12.5	33.9	22.3	11.6	5.3	7.7
Winter	55.1	9.8	34.5	21.9	12.6	4.2	10.9
Robinia							
Spring	61.9	23.9	37.7	24.5	13.2	6.4	9.8
Winter	57.8	14.5	44.2	27.9	16.4	8.8	6.9
Mulberry							
Spring	64.9	17.6	26.0	22.8	3.2	5.4	14.5
Winter	60.9	13.7	28.0	22.2	6.00	5.6	11.4
Elaeagnus							
Spring	65.6	14.9	37.5	21.0	16.5	2.5	7.1
Winter	46.7	13.9	31.0	20.8	10.2	5.8	11.8
Populus							
Spring	56.8	11.3	32.6	23.9	8.7	7.9	8.5
Winter	49.2	10.0	30.5	23.2	7.2	4.1	10.7
Ailanthus							
Spring	65.3	27.2	22.3	17.9	4.4	4.8	9.4
Winter	66.3	10.5	26.0	18.3	7.7	2.6	13.5
Mean±SE							
Spring	61.5±1.9	17.9±2.0	31.7±2.5	22.1±0.9	9.6±2.1	5.4±0.7	9.5±1.1
Winter	56.0±2.9	12.0±0.9	32.4±2.6	22.4±1.3	10.0±1.6	5.2±0.9	10.9±0.9

($p<0.05$) during spring compared to winter (61.5%±1.9 vs 56%±2.8). Similarly, CP content in leaves of all the species were higher ($p<0.05$) during spring compared to winter (17.9%±2.6 vs 12.04%±0.9). In spring, maximum CP (27.2 %) was found in the leaves of Ailanthus followed by Robinia (23.9%) while minimum CP (11.3%) was recorded in Populus. The CP values obtained in this study are comparable with the values (CP 10-28%) reported by Singh, 1982; Papachristou and Pananastasis, 1994; Shavo, 1997; Subba, 1998. Leaves of Salix, Elaeagnus, Populus and Ailanthus contained the higher ($p<0.05$) levels of ash content during winter, whereas, leaves of Robinia and Mulberry contained high level of ash during spring.

Neutral detergent fibre (NDF) values of leaves of Robinia and Elaeagnus were highest both in winter and spring, respectively, whereas, no seasonal difference was found in other species. Maximum value of hemicellulose was found in Robinia (16.35%) during winter and in Elaeagnus (16.50%) during spring. There was no difference ($p<0.5$) in cell wall constitute. In summary, it may be concluded that considerable variations were observed among the species and seasons in the nutrient profile of fodder tree leaves.

Apparent in situ DMD : *In situ* DMD of different fodder tree leaves harvested in spring and winter is presented in table 2. *In situ* DMD was ($p<0.05$) higher in spring in Ailanthus, Robinia and Populus compared to winter, whereas, the higher DMD digestibility was observed in Mulberry and Elaeagnus in winter. These results are in line with those obtained by Shavo (1997) and Subba (1998). No seasonal effect ($p<0.05$) was noticed in *in situ* DMD of Salix. A considerable variation in *in situ* DMD of fodder tree leaves in spring and winter seasons was observed as 74.7%±1.9 and 68.2%±1.2, respectively. These results are in agreement with Subba (1998) who reported a wider range of variation in digestibility of fodder tree leaves in different seasons and the rang of overall DMD was 37 to 80% and CPD was 35 to 88% in 33 different tree fodder leaves.

Table 2. *In situ* dry matter digestibility (%) of various fodder tree leaves at 48 h after incubation

Specie	Seasons	
	Spring	Winter
Salix	73.82±4.26[a]	71.27±2.57[a]
Robinia	74.19±2.13[a]	65.66±2.38[b]
Mulberry	69.80±2.09[b]	77.74±2.18[a]
Elaeagnus	66.17±1.89[b]	71.20±1.14[a]
Populus	77.92±1.55[a]	64.20±2.88[b]
Ailanthus	78.56±2.85[a]	67.26±3.21[b]
Mean±SE	74.73±1.90[a]	68.23±1.22[b]

Value with different superscripts in the same row differ significantly ($p<0.05$).

Table 3. Nutrient composition of experimental rations (% DM)

Parameters	A Salix	B Robinia	C Mulberry	D Elaeagnus
Dry metter (%)	88.7	88.3	89.0	88.9
Crude protein	15.0	15.0	14.3	14.9
Crude fiber	15.8	15.9	18.8	17.0
Ash	9.9	10.9	14.5	10.8
Total digestible Nutrients*	67.1	68.1	68.7	69.5

* Calculated value.

Experiment 2

Apparent in vivo digestibility and nitrogen balance : Data on DM, CP and CF intake of the rations and their digestibility are presented in table 4. The data suggested that the intake of DM was higher ($p<0.05$) on ration A (Salix) compared to rations B (Robinia) and D (Elaeagnus). DMI of ration C (Mulberry) was lowest ($p<0.05$) compared to other rations. Similar trends were observed for CP and CF intakes. Present results of intakes are in accordance with the findings of Raghavan (1989) who reported that either green or dried tree leaves fed with concentrate became a valuable feed resource for ruminants. DMD was found to be the highest ($p<0.05$) in goats fed on rations A (61.7%) and D (59.3%) compared to rations C (53.9%) and B (52.3%). Almost similar pattern of CP and CF digestibility was observed for all the experimental rations. Though chemical composition of leaves indicated that Robinia and Mulberry are good fodder but the nutrients utilisation from these leaves was found low in goats. This might be due to high tannin content present in Robinia and Mulberry leaves which interfered with protein and dry matter digestion and resulted the low digestibility. Present findings are substantiated by Horton and Christensen (1981). Raharjo et al. (1990), Ayers et al. (1996) who observed reduced digestibility of DM and CP in Robinia. The present findings are corroborated with that of Subba (1998).

Nitrogen Balance : Results of nitrogen balance trial are presented in table 6. Nitrogen intake was noticed to be ($p<0.05$) higher on ration A (36.8 g/d), and D (34.6 g/d) compared to C (31.9 g/d). Daily nitrogen retention was found to be ($p<0.05$) higher on ration A compared to other experimental rations. Minimum nitrogen retention as percent of intake was found in goats fed ration B having robinia leaves.

CONCLUSION

Considerable variations were observed in the nutrient profile among the species and seasons of different fodder tree leaves. The results further suggested that leaves of

Table 4. Nutrient intake, digestibility and nitrogen retention in goats fed different experimental rations

Parameter	A (salix)	B (robinia)	C (mulberry)	D (elaeagnus)
Nutrient Intake g/d				
Dry matter	1.526±14.4[a]	1,438±5.2[b]	1.296±5.5[c]	1.450±15.6[b]
Crude protein	230±2.3[a]	222±2.1[a]	199±0.8[b]	216±1.5[a]
Crude fiber	241±2.5[a]	228±0.74[b]	225±1.1[b]	246±1.8[a]
Digestibility (%)				
Dry matter	61.7±1.7[a]	52.3±2.5[b]	53.9±2.0[b]	59.5±2.4[a]
Crude protein	64.6±1.8[a]	57.8±1.4[b]	62.2±2.5[a]	61.2±1.5[a]
Crude fiber	53.2±1.2[a]	50.0±0.9[b]	53.9±1.5[a]	55.9±1.3[a]
Nitrogen retention (%) of intake	38.0±1.9[a]	33.6±1.5[b]	32.3±2.6[b]	33.1±2.0[b]

Values with different superscripts in the same row differ significantly ($p<0.05$).

Salix, Elaeagnus, Mulberry tree when supplemented with concentrate feed at 50% level in total mixed rations helped to achieve moderate intake and normal digestibility in goats.

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