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Chemical composition and *in sacco* degradibility of some fodder tree leaves, shrub leaves and herbaceous plants

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ABSTRACT

Samples of leaves of 15 fodder plants, 5 each of tree (*bauhinia variegata, Delbergia sisso, Browossonitia paprifera, Ficus infectoria, Toona ciliata*) and shrubs (*Hibiscus* spp, *Murraya koenigii, Psidium guajava, Zizyphus jujba, Carissa carandus*) and 5 of herbaceous plants (*Dryopteris* spp., *Ipomoea nil, Phragmites communis, Cynodon dactylon, Brachiaria mutica*) occurring in Tarai area of Uttaranchal were evaluated for their nutritional value. The OM, CP, NDF, ADF, hemicellulose, cellulose, lignin, ash, calcium, phosphorus and tannin content in leaves of different fodder trees/shrubs and herbaceous plants ranged from 81.3 to 93.5, 10.4 to 18.9, 28.6 to 68.5, 21.5 to 44.8, 2.4 to 27.5, 14.8 to 39.1, 5.6 to 17.4, 6.5 to 18.8, 1.4 to 3.4, 0.1 to 0.4 and 0.9 to 7.5% respectively. A significant difference in chemical constituents of leaves of different fodder species was observed. The *in sacco* dry matter degradation pattern indicated that in leaves of different fodder species it increases with time. At 0 h incubation time dry matter degradation was highest in *Toona ciliata* (25.4%) followed by *Hibiscus* spp.(23.4%), *Murraya koenigii* (22.7%), *Brachiaria mutica* (21.3%), *Ipomoea nil* (20.8%), *Browossonitia paprifera* (20.5%) and lowest being in *Psidium guajava* (13.0%) indicating the presence of rapidly soluble fraction.

Keeping in view the results obtained, it may be concluded that the leaves of *Toona ciliata, Browossonitia paprifera* (trees), *Murraya koenigii, Hibiscus* spp. (shrubs) and *Cynodon dactylon, Brachiaria mutica, Ipomoea nil* (herbaceous plants) are higher in nutritive value. Inclusion of edible parts of them in the diet of ruminant animals would be greatly beneficial in increasing productivity of livestock and decreaseing the cost of production.

Key words: Fodder tree leaves, *In-sacco* dry matter degradation, Nutritive value, Tannin content

Shortage of good quality feed and fodders is the major constraint in the prevalent system of livestock production in India. The total requirement for green fodder, dry fodder and concentrate is 761 million tons, 650 million tons and 79.4 million tones respectively while the availability of green fodder, dry fodder and concentrate is only 57.3 million tonnes, 387 million tons and 42 million tons respectively (Ranjan 1997). A survey conducted earlier shows that 66% of the total dry matter comes from forests as tree leaves and forest floor litter, while 34% is contributed from the cultivated land (Singh and Naik, 1987). Tree leaves can play important role in mitigating the shortage of protein in the diet of ruminant animals (Joshi and Upadhyay 1976). The present study was undertaken to determine the chemical composition and *in sacco* dry matter degradability of tree leaves, shrub leaves and herbaceous plants found in Uttaranchal around Pantnagar.

MATERIAL AND METHODS

Samples of 5 types of tree leaves (*Bauhinia variegata, Delbergia sisso, Browossonitia paprifera, Ficus infektoria, Toona ciliata*), shrub leaves (*Hibiscus* spp, *Murraya koenigii, Psidium guajava, Zizyphus jujuba, Carissa carandus*) and herbaceous plants (*Dryopteris* spp., *Ipomoea nil, Phragmites communis, Cynodon dactylon* and *Brachiaria mutica*) were collected from Tarai area around Pantnagar in Uttaranchal. Standards methods were followed to analyse samples of fodder species for dry matter and organic matter (AOAC 1990), crude protein (ISI 1962), cell wall constituents (Goering and Vansoest 1970) and tannin (Krishana and Ranjhan 1981). *In sacco* dry matter degradation was determined (Mehrez and Orskov 1977) using 3 fistulated bullocks. Sample (58) having particle size of 2 mm was kept in nylon bags of the size 17 cm × 9 cm for 0, 24, 48, 72 and 96 h incubation periods. The basal diet of experimental bullocks was 5 kg wheat straw plus 2 kg green maize and 2 kg concentrate mixture (20% CP and 70% TDN). The fodder tree leaves were scored by the selection index method as described Pal *et al.* (1979). The data were analyzed statistically using CRD as per Snedecor and Cochran (1968).

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RESULTS AND DISCUSSION

Dry matter, organic matter and crude protein content varied widely among different species (Table 1). The dry matter content varied from 12.2 (*Ipomoea nil*) to 45.3% (*Cynodon dactylon*) and organic matter content varied from 85.9 (*Browossonitia paprifera*) to 93.5% (*Hibiscus* spp.). These results are in agreement with the findings of Devaranjan (1999) and Khatta *et al.* (1999) who observed a wide variation in dry matter and organic matter content among different tree leaves. The crude protein content varied significantly ($P<0.05$) among species from 10.4 (*Phragmites communis*) to 18.9%(*Browossonitia paprifera*). These results are in agreement with the findings of Mittal *et al.* (1998), Devaranjan (1999), Singh (1999) and Sharma *et al.* (2000) who reported a wide variation in crude protein content among different tree leaves. The NDF content was highest in *Cynodon dactylon* (68.5%) and lowest in *Hibiscus* spp. (28.5%). NDF contents of *Bauhinia variegata, Ficus infectoria, Browossonitia paprifera* and *Brachiaria mutica* did not differ significantly ($P<0.05$) among them but differed significantly ($P<0.05$) from other species. These result are in agreement with the findings of Khatta *et al.* (1999) who reported wide variation in NDF content among tree leaves. The ADF varied from 44.8 (*Cynodon dactylon*) to 21.5% (*Hibiscus* spp.). These results are in agreement with findings of Lohan *et al.* (1980) and Yadava *et al.* (2003). Tannin content in leaves of *Murraya koenigii, Hibiscus* spp. and *Phragmites communis* was lower as compared to other species. The lignin content varied from 5.6 (*Cynodon dactylon*) to 17.3% (*Carissa carandus*). These results are in agreement with findings of Khatta *et al.* (1999). The *in sacco* dry matter degradation increased with time. At 0 h incubation time dry matter degradation was highest in *Toona ciliata* (25.4%) followed by *Hibiscus* spp.(23.4%), *Murraya koenigii* (22.7%), *Brachiaria mutica* (21.3%), *Ipomoea nil* (20.8%), *Browossonitia paprifera* (20.5%) and lowest being in *Psidium*

Table1. Chemical composition of tree leaves, shrubs leaves and herbaceous plants,% DM basis

Species	Organic matter	Crude protein	NDF	ADF	Hemi-cellulose	Cellulose	Lignin	Ash	Calcium	Phosphorus	Tannin
Trees											
Bauhinia variegata	89.8^{cd}	16.1^{cd}	50.7^{d}	31.1^{cd}	19.6^{bc}	18.5^{b}	12.7^{e}	10.3^{bc}	2.0^{bc}	0.4^{i}	7.5^{d}
Toona ciliata	90.0^{d}	15.4^{c}	35.3^{b}	29.6^{cd}	5.7^{a}	19.2^{bc}	10.5^{d}	10.0^{bc}	2.2^{b}	0.2^{a}	2.8^{b}
Ficus infectoria	87.9^{c}	16.2^{cd}	50.3^{d}	38.9^{cd}	19.4^{bc}	23.3^{d}	7.6^{bc}	12.1^{cd}	1.5^{ab}	0.2^{d}	2.8^{b}
Browossonitia paprifera	85.9^{b}	18.9^{d}	51.0^{d}	29.4^{c}	21.6^{bc}	22.5^{cd}	6.9^{b}	14.10^{d}	3.4^{c}	0.3^{f}	1.6^{a}
Delbergia sisso	90.1^{d}	16.1^{cd}	44.3^{c}	26.7^{b}	17.6^{b}	15.9^{a}	10.7^{d}	9.9^{bc}	2.4^{b}	0.2^{b}	4.1^{c}
Shrubs											
Zizyphus jujuba	91.3^{d}	16.4^{cd}	40.7^{c}	38.3^{f}	2.4^{a}	21.5^{cd}	16.8^{f}	8.7^{b}	2.6^{b}	0.3^{f}	3.6^{c}
Carissa carandus	89.4^{cd}	10.6^{a}	44.5^{c}	38.6^{f}	5.9^{a}	21.2^{c}	17.4^{f}	10.6^{bc}	2.3^{b}	0.2^{a}	1.6^{a}
Murraya koenigii	87.1^{bc}	16.5^{cd}	29.4^{a}	25.3^{b}	4.1^{a}	16.9^{ab}	8.5^{c}	12.9^{cd}	1.9^{ab}	0.1^{a}	0.9^{a}
Psidium guajava	88.2^{c}	12.1^{b}	40.3^{c}	35.0^{e}	5.3^{a}	18.8^{b}	16.2^{f}	11.8^{c}	1.6^{ad}	0.2^{c}	1.4^{a}
Hibiscus spp.	93.5^{e}	16.1^{cd}	28.6^{a}	21.5^{a}	7.1^{a}	14.8^{a}	6.7^{ab}	6.5^{a}	2.4^{b}	0.3^{e}	0.9^{a}
Herbaceous plants											
Dryopteris spp.	81.3^{a}	16.9^{d}	38.4^{bc}	31.4^{e}	7.0^{a}	18.4^{b}	13.0^{e}	18.8^{e}	1.7^{ad}	0.34^{fg}	4.3^{c}
Phragmites communis	86.0^{b}	10.4^{d}	66.8^{e}	39.3^{f}	27.5^{e}	31.7^{f}	7.6^{bc}	14.0^{d}	1.9^{ab}	0.16^{b}	0.9^{a}
Cynodon dactylon	90.9^{d}	15.4^{c}	68.6^{e}	44.8^{g}	23.7^{e}	39.1^{g}	5.6^{a}	9.1^{b}	1.4^{a}	0.16^{b}	1.1^{a}
Brachiaria mutica	88.0^{c}	11.5^{ab}	53.6^{d}	35.3^{e}	18.3^{b}	28.3^{e}	7.0^{b}	12.1^{cd}	1.5^{ab}	0.36^{h}	1.12^{a}
Ipomoea nil	86.5^{c}	15.7^{cd}	41.0^{c}	36.6^{ef}	4.4^{a}	27.7^{e}	8.9^{c}	13.5^{cd}	1.8^{ab}	0.34^{g}	2.36^{b}

Figure in the same column with different superscript differed significantly ($P<0.05$).

Table 2. Nylon bag dry matter degradability of different fodder tree leaves, shrubs leaves and herbaceous plants,% DM basis

Species	0 h	24 h	48 h	72 h	96 h
Trees					
Bauhinia variegata	18.7	47.0	53.1	69.8	76.5
Toona ciliata	25.4	41.1	50.9	68.2	73.5
Ficus infectoria	13.2	27.6	31.3	45.3	56.3
Browossonitia paprifera	20.5	58.3	67.8	83.2	87.1
Delbergia sisso	16.8	39.5	40.8	53.6	55.3
Shrubs					
Zizyphus jujuba	15.9	25.2	34.4	54.0	60.8
Carissa carandus	13.0	37.3	48.5	55.5	58.1
Murraya koenigii	22.7	49.3	63.5	75.2	79.2
Psidium guajava	13.0	19.4	26.3	31.0	42.2
Hibiscus spp.	23.4	57.6	63.9	82.0	84.5
Herbaceous plants					
Dryopteris spp.	15.8	27.8	30.3	59.4	64.8
Phragmites communis	16.8	35.9	37.8	51.6	57.6
Cynodon dactylon	15.8	35.8	42.3	57.6	59.7
Brachiaria mutica	21.3	42.2	48.3	69.7	71.5
Ipomoea nil	20.8	47.8	60.4	73.5	77.1

Table 3. Scoring of fodder tree leaves, shrub leaves and herbaceous plants on the basis of average CP, tannin, NDF, lignin and DM digestibility

Species	Crude Protein		Tannin		NDF		Lignin		DMD		Total
	% in DM	Score (a)	% in DM	Score (b)	% in DM	Score (c)	% in DM	Score (d)	% in DM	Score	
Trees											
Bauhinia variegata	16.10	10	7.48	1	50.73	5	12.65	5	69.89	11	32.0
Toona ciliata	15.35	5	2.80	5.5	35.28	13	10.43	7	68.15	9	39.5
Ficus infectoria	16.15	11	2.80	5.5	50.28	6	7.55	11	45.25	2	35.5
Browossonitia paprifera	18.94	15	1.55	8.5	50.98	4	6.87	13	83.23	15	55.5
Delbergia sisso	16.09	8	4.05	3	44.27	8	10.73	6	53.62	4	29.0
Shrubs											
Zizyphus jujuba	16.42	12	3.61	4	40.68	10	16.81	2	54.04	5	33.0
Carissa carandus	10.58	2	1.55	8.5	44.46	7	17.38	1	55.50	7	25.5
Murraya koenigii	16.46	13	0.93	14	29.41	14	8.45	9	75.28	13	63.0
Psidium guajava	12.13	4	1.37	10	40.32	11	16.21	3	31.04	1	29.0
Hibiscus spp.	16.10	9	0.93	14	28.64	15	6.69	14	81.98	14	66.0
Herbaceous plants											
Dryopteris spp.	16.93	14	4.30	2	38.38	12	13.02	1	54.43	6	38.0
Phragmites communis	10.35	1	0.93	14	66.84	2	7.63	10	51.55	3	30.0
Cynodon dactylon	15.38	6	1.05	12	68.46	1	5.62	15	57.64	8	42.0
Brachiaria mutica	11.46	3	1.12	11	53.56	3	6.98	12	69.67	10	39.0
Ipomoea nil	15.72	7	2.36	7	41.00	9	8.91	8	73.45	12	43.0

guajava (13.0%) indicating the presence of rapidly soluble fraction. The dry matter degradation at 72 h incubation time was found highest in *Browossonitia paprifera* (82.2%) followed by *Hibiscus spp.* (82.0%), *Murraya koenigii* (75.3%), *Ipomoea nil* (73.5%), *Bauhinia variegata* (69.8%) and lowest being in *Psidium guajava* (31.04%). These results are in agreement with the finding of Yadava *et al.* (2003). He reported that the dry matter degradation was highest in *Browossonitia paprifera*. He also found increasing trend in dry matter degradation with increase in time. In present study, similar variation in dry matter degradation was found in leaves of different fodder species.

On the basis of overall nutritive analysis and scoring, it can be concluded that leaves of *Toona ciliata, Browossonitia paprifera, Murraya koenigii, Hibiscus* spp. and *Cynodon dactylon, Brachiaria mutica, Ipomoea nil* (herbaceous plants), fodder species have high nutritive value as compared to other species under investigation.

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REFERENCES

AOAC: 1990. *Official Methods of Analysis.* 15th edn. Association of Official Analytical Chemists (Ed), Kenneth Helrich. Virginia, USA.

Devarangan S. 1999. 'Effect of tannins on the ruminal degradation kinetics of locally available tree forages'. M.V.Sc. Thesis, Indian Veterinary Reasearch Institute, Izatnagar Uttar Pradesh, India.

Goering H K and Vanosoest P J. 1970. *Forage Fibre Analysis-Apparatus, Reagents, Procedures and some Applications. Agricultural Handbook* No. 379, ARS, USDA Washington DC.

ISI. 1962. *Specification for Balanced Feed Mixture for Cattle* IS: 2051–1962. Indian Standard institution, New Delhi.

Joshi D C and Upadhyay R B. 1976. *Leucaena leucocephala* an evergreen protein rich tree fodder and the possibility of using it in the diet of animals. 1. Sheep. *Indian Veterinary Journal* **53**: 606.

Khatta V K, Tewatia B S and Gupta P C. 1999. Evaluation of tree leaves of humid subtropical region of Himanchal Pradesh. *Indian Journal of Animal Nutrition* **16**: 220–23.

Krishana G and Ranjhan S K. 1981. *Laboratory Manual for Nutrition Research.* Vikas Publishing House Private Ltd., New Delhi.

Lohan O P, Lall D, Pal R N and Negi S S. 1980. Cell wall constituent and *in vitro* dry matter digestibility of some fodder trees in Himachal Pradesh. *Forage Research* **6**: 21–27.

Mehrez A Z and Orskov E R. 1977. A study of artificial fibre bag technique for determining the digestibility of foods in rumen. *Journal of Agricultural Science* **88**: 645–50.

Mittal G K, Sharma K M, Maheshwari M I and Barsaul C S. 1988. Chemical composition of some naturally available fodder resources in hill area of Chakrata (UP). *Indian Journal of Animal Nutrition* **5**: 341–94.

Pal, R N, Dogra K K, Singh L N and Negi S S. 1979. Chemical composition of some fodder trees in Himachal Pradesh. *Forage Research* **5**: 109–15.

Ranjhan S K. 1997. Feeding strategies for supporting higher livestock and poultry. *National symposium on feeding strategies for ecoforiendly animal production in India.* Animal Nutrition

Association. Feb. 1997 pp 65–75. IVRI, Izatnagar.

Sharma R K, Singh B and Bhatt T K. 2000. Nitrogen solubility, protein fractions of tannins and *in sacco* dry matter digestibility of tree fodders of Shivalik range. *Indian Journal of Animal Nutrition* **17**: 1–7.

Singh K K. 1999. Nutrient contents in tree fodder and bamboo leaves of eastern Himalaya. *Indian Journal of Animal Nutrition* **16**: 178–82.

Singh V and Naik D G. 1987. Fodder resources of central Himalayas. *Western Himalayan: Environment, Problems and Development.* **1**: 223–241. (Eds) Pangtey Y P S and Joshi S C. Gynodaya Prakashan, Nainital.

Snedecor G W and Cochran W G. 1968. *Statistical Methods*. Indian edn. Oxford and I.B.H. Publishing Co. New Delhi.

Yadava A K, Kumar A and Singh V. 2003. Nutritive evaluation of some native fodder plants in the hill and the tarai region of Uttaranchal. *Indian Journal of Animal Sciences* **73**: 793–97.