

## BIBECHANA

A Multidisciplinary Journal of Science, Technology and Mathematics

ISSN 2091-0762 (online)

Journal homepage: <http://nepjol.info/index.php/BIBECHANA>

# Chemical analysis of fodder tree leaves found in Sunsari district, Nepal

T.N. Mandal<sup>1</sup> and T.P. Gautam<sup>2\*</sup>

<sup>1</sup>Department of Botany, Post Graduate Campus (Tribhuvan University), Biratnagar

<sup>2</sup>Department of Botany, Mahendra Morang A. M. Campus (Tribhuvan University), Biratnagar

\*Corresponding author: Tilak Prasad Gautam, Department of Botany, M.M.A.M. Campus (Tribhuvan University), Biratnagar, Nepal, Email: [tilakg673@gmail.com](mailto:tilakg673@gmail.com)

*Article history: Received 10 October, 2011; Accepted 4 January, 2012*

### Abstract

Altogether 55 fodder trees were collected with their local information from Sunsari district, Nepal. Among them, the leaves of 19 fodder trees were analyzed for dry matter, crude protein, ether extract, crude fibre, N-free extract, total ash and mineral contents (K, Ca, and P). Regarding fodder quality, local information and chemical composition do not match for all plants. On the basis of chemical composition 12 fodder trees were recognized as good fodders. On the basis of both local information and chemical composition following trees were assessed as very good fodders: *Artocarpus heterophyllus*, *Bauhinia variegata*, *Ficus cunia*, *F. glomerata* and *F. lacor*.

**Keywords: Tree fodders; Farmers' assessment; Proximate analysis; Nutrient contents**

## 1. Introduction

Fodder plants are the important source of green fodders for livestock. The grasses, herbs, shrubs, vines and trees may be the source of green fodders. In Sunsari district fodder trees are the major source of such green fodders which are collected from the nearby forest in Bhabar to hilly region. The fodder leaves of some tree species are almost as nutritious as that of the leguminous forage crops. Several works on fodder plants have been done in Nepal in connection with pasture and fodder development, livestock development and afforestation programme, cited by Mandal [1]. Stebler [2] reported the chemical composition of leaves of 13 fodder trees found in the Jiri region. Dutt [3] determined the nutritive values of 17 tree fodders from the Annapurna region. The fodder trees from different hill forests of Kathmandu valley have been identified and analyzed for their nutrient contents by Bajracharya et al. [4 and 5]. Pandey [6] reported the chemical composition and nutritive constituents of 49 tree fodder found in Nepal.

The information on the availability of fodder trees and nutrient contents in their leaves from Sunsari district, Nepal, has been documented. The work was carried with the following objectives: i) to identify the fodder trees along with local information ii) to analyze the chemical composition of the fodder leaves iii) to recognize the nutritive fodders on the basis of chemical composition and local information.

## Study area

Sunsari district, covering an area of 1265 Km<sup>2</sup>, lies at the southern part of Koshi zone of Nepal. It is located between 26° 23'- 26° 55' N and 87° 05'- 87° 21' E.

The topographical variations range from 152- 914 meters within the district. There are three distinct regions within the district. The northern part is covered by the hills; middle part is occupied by bhabar region, the south face of which is covered by Charkoshe Jungle. The southern plain part is terai.

## Climate and vegetation

The south terai and bhabar regions have tropical climate while the north hilly region has subtropical type of climate. The monsoon starts usually in May and lasts till October. The average annual rainfall is 2154.1mm. The minimum and maximum temperature is 14.2° C and 30.6° C. Vegetational zone varies due to climatic and topographic variation. There are two vegetation zones namely tropical and subtropical. The representative tree species are *Dalbergia sissoo*, *Terminalia bellerica* in tropical and *Castanopsis indica*, *Schima wallichii* in subtropical zone.

## 2. Materials and Methods

Fodder tree leaves were collected from different regions namely terai, bhabar and hilly region of Sunsari district. The collection of plant samples was done in different feeding seasons in which the farmers use to feed their livestock.

Plants were identified as fodder by applying them to the grazing animals in the field and by observation on farmers' collection who regularly collect fodder from the forest. The information about local names, quality and availability of fodder plants were recorded with the help of local experienced farmers. Fodder leaves were collected in polythene bags and kept air-tight till the fresh weight was taken. The plants were then allowed to air-dry.

Fodder tree leaves were kept in hot air oven at 60°- 70°C for 48 hours and then the dry samples were kept at 103°C temperature for 4 hours to determine dry matter content. Oven dried fodder samples were powdered and packaged in air- tight small polythene bags for further chemical analysis.

## Chemical analysis

Chemical analysis was done on dry matter basis. For each analysis triplicate samples were used. Crude protein content was estimated by multiplying the percentage of nitrogen by a factor 6.25. The percentage of nitrogen was determined by Micro-Kjeldahal technique [7]. Ether extract (crude fat) was determined by the Soxhlet apparatus. Extraction was done in petroleum ether having boiling point 40°C- 60°C [8]. Crude fibre content was estimated from the fat free oven dried samples following the method described by I.S.I. [8]. Nitrogen free extract was estimated by subtraction method. The sum of total crude protein, ether extract, crude fibre and total ash was subtracted from 100 [9].

Total ash content was determined by heating the ground material in a dry crucible on a low flame and then it was heated in muffle furnace at 600°C for 3- 4 hours [7]. Potassium, Calcium and Phosphorus contents were determined from the ash samples. Potassium was estimated by flame photometric method and Calcium was estimated by titration method as described by Jackson [10]. Estimation of phosphorus was done colorimetrically according to A.O.A.C. [11].

### 3. Results

Altogether 55 fodder trees were reported from different parts of Sunsari district. They have been arranged alphabetically with their local names (Nepali names) and respective families in Table 1. All the fodder trees were belonged to 29 families and 40 genera. The highest number of fodder trees (12 species) was found under the family Moraceae followed by 8 tree species of the family Leguminosae (added number of its sub- families).

#### Local information on fodder trees

Local information on fodder trees for their qualities, availability, feeding seasons, preference by livestock and distributions were collected during the field study with the help of local experienced farmers. The information is listed in Table 2. The qualities are rated as fairly good, good and very good. Leaves of fodder trees are fed to the ruminants mainly in the winter. The preference of fodder trees by the ruminants was surveyed. For this purpose the ruminants have been grouped as cow- buffalo group and goat group. Many of the fodder species have been consumed by both of these groups with equal interest. However, few fodder species were consumed by the goats only. The distribution of fodder trees varies according to the locality. Many fodder trees are distributed in the bhabar, siwalik and upper hills.

Fodder plants are fed at their different stages of growth. In case of trees, generally the tender twigs are given to the livestock. But some fodder species namely *Celtis australis* and *Eurya acuminata* cause diarrhea and other ill effects if they are fed at immature stage. Similarly, *Prunus cerasoides* is not fed to lactating animals as it decreases the milk yield. In contrast, the fodder species namely *Artocarpus lakoocha*, *Ficus glomerata* and *Ficus nemoralis* are generally fed to the lactating animals to increase the milk yield.

#### Chemical analysis of fodder tree leaves

Altogether, 19 fodder trees were selected on the basis of availability, preference by ruminants and local information. The leaves of these species were analyzed for their dry matter, crude protein, ether extract, crude fibre, N-free extract, total ash and mineral contents (Potassium, calcium and phosphorus). The estimated values of these constituents are given in Table 3 and 4.

Dry matter content ranged from 19.25-48.61%, which was in *Madhuca longifolia* and maximum in *Albizia lebbek*. Nearly 63% fodder tree leaves contained more than 35% dry matter. Crude protein content ranged from 9.73- 21.35%. Lowest crude protein was observed in *Madhuca longifolia* and highest in *Albizia lebbek*. Nearly 53% of the fodder tree leaves contained more than 14% crude protein. Ether extract ranged from 2.32-6.45% among the fodder trees. The amount of ether extract was significantly lower. It was less than 5% in all fodder trees except *Morus alba* (6.5%). Crude fibre content ranged from 14.87-31.54% among the tree fodders, minimum in *Morus alba* and maximum in *Albizia lebbek*. Almost 53% of the tree fodders contained more than 20% of crude fibre.

Nitrogen- free extract content ranged from 36.47- 57.71% with the lowest value in *Albizia lebbek* and highest value in *Madhuca longifolia*. Total ash content among fodder trees ranged from 7.84- 15.63%, minimum in *Schleichera oleosa* and maximum in *Kydia calycina*. Potassium content ranged from 1.12- 2.23%, with the lowest value in *Terminalia alata* and highest value in *Artocarpus heterophyllus* and *Morus alba*. Calcium content ranged from 1.61- 4.21%. The highest value was observed in *Celtis australis*. Most of the trees had more than 2.0% calcium content in dry matter. Phosphorus content ranged from 0.14- 0.37% among the tree fodders. *Kydia calycina* had highest phosphorus content

**Table 1:** Fodder trees of Sunsari district, their local names (Nepali names) and families

S. N.	Species	Local name	Family
1	<i>Acacia catechu</i> (L. f.) Willd.	Khayar	Mimosaceae
2	<i>Aegle marmelos</i> (L.) Correa	Bel	Rutaceae
3	<i>Albizia lebbek</i> (L.) Benth.	Siris	Mimosaceae
4	<i>Anthocephalus chinensis</i> Hassk.	Kadam	Rubiaceae
5	<i>Artocarpus heterophyllus</i> Lamk.	Katahar	Moraceae
6	<i>Artocarpus lokoocha</i> Roxb.	Badahar	Moaceae
7	<i>Bauhinia purpurea</i> L.	Tanki	Caesalpinaceae
8	<i>Bauhinia variegata</i> L.	Koiralo	Caesalpinaceae
9	<i>Bombax ceiba</i> L.	Simal	Bombacaceae
10	<i>Castanopsis indica</i> (Roxb.) Miq.	Dhalne Katus	Fagaceae
11	<i>Castanopsis tribuloides</i> (Sm.) A. DC.	Musure Kattus	Fagaceae
12	<i>Celtis australis</i> L.	Khari	Ulmaceae
13	<i>Dalbergia sissoo</i> Roxb.	Sisau	Papilionaceae
14	<i>Dalbergia stipulacea</i> Roxb.	Tantebari	Papilionaceae
15	<i>Dillenia pentagyna</i> Roxb.	Tantari	Dilleniaceae
16	<i>Diploknema butyracea</i> (Roxb.) Lam.	Chiuri	Sapotaceae
17	<i>Erythrina variegata</i> L.	Phaledo	Papilionaceae
18	<i>Eurya acuminata</i> DC.	Thulo Jhigane	Theaceae
19	<i>Ficus auriculata</i> Lour.	Newaro	Moraceae
20	<i>Ficus bengalensis</i> L.	Bar	Moraceae
21	<i>Ficus benjamina</i> L.	Sami	Moraceae
22	<i>Ficus cunia</i> Buch.-Ham ex Roxb.	Khanyu	Moraceae
23	<i>Ficus glomerata</i> Roxb.	Gular	Moraceae
24	<i>Ficus hispida</i> L.	Khasreto	Moraceae
25	<i>Ficus lacor</i> Buch.-Ham.	Kabro	Moraceae
26	<i>Ficus nemoralis</i> Wall. ex Miq.	Dudhilo	Moraceae
27	<i>Ficus religiosa</i> L.	Pipal	Moraceae
28	<i>Garuga pinnata</i> Roxb.	Dabdabe	Burseraceae
29	<i>Grewia tiliaefolia</i> Vahl.	Syalphusro	Tiliaceae
30	<i>Kydia calycina</i> Roxb.	Kubinde	Malvaceae
31	<i>Lagerstroemia parviflora</i> Roxb.	Bot Dhayero	Lythraceae
32	<i>Litsea polyantha</i> Juss.	Kutmiro	Lauraceae
33	<i>Madhuca longifolia</i> (Koeing) Macbride	Mauwa	Sapotaceae
34	<i>Maesa chisia</i> Buch.-Ham. ex D. Don	Bilaune	Myrsinaceae
35	<i>Mallotus philippinensis</i> Muell. Arg.	Sindure (Rohini)	Euphorbiaceae
36	<i>Melia azedarach</i> L.	Bakaino	Meliaceae
37	<i>Moringa oleifera</i> Lamk.	Saijan	Moringaceae
38	<i>Morus alba</i> L.	Kimbu	Moraceae
39	<i>Myrsine capitellata</i> Wall.	Seti Kath	Myrsinaceae
40	<i>Persea odoratissima</i> (Nees) Kosterm.	Seto Kaulo	Lauraceae
41	<i>Premna bengalensis</i> Clarke	Gineri	Verbenaceae
42	<i>Prunus cerasoides</i> D. Don	Painyu	Rosaceae
43	<i>Schima wallichii</i> (DC.) Korth.	Chilaune	Theaceae
44	<i>Schleichera oleosa</i> (Laur.) Oken	Kusum	Sapindaceae
45	<i>Shorea robusta</i> Gaertn.	Sal	Dipterocarpaceae
46	<i>Spondias pinnata</i> (L.f.) Kurz	Amaro	Anacardiaceae
47	<i>Syzygium cumini</i> (L.) Skeels	Jamun	Myrtaceae
48	<i>Tamarindus indica</i> L.	Titri	Caesalpinaceae
49	<i>Terminalia alata</i> Heyne ex Roth.	Sahaj	Combretaceae
50	<i>Terminalia bellirica</i> C. B. Clarke	Barro	Combretaceae
51	<i>Terminalia chebula</i> Retz.	Harro	Combretaceae
52	<i>Terminalia myriocarpa</i> Heurcken.	Pani Sahaj	Combretaceae
53	<i>Trichilia connaroides</i> (Wt. & Arn.) Benth.	Ankhataruwa	Meliaceae
54	<i>Woodfordia fruticosa</i> (L.) S. Kurz	Dhayero	Lythraceae
55	<i>Zizyphus mauratiana</i> Lamk.	Bayar	Rhamnaceae

**Table 2:** Local information on fodder trees

S. N.	Species	Quality	Feeding season	Preference of ruminants	Distribution
1	<i>Acacia catechu</i>	++	W	XY	TBS
2	<i>Aegle marmelos</i>	+	W	Y	TBS
3	<i>Albizia lebbek</i>	+	S	Y	TBS
4	<i>Anthocephalus chinensis</i>	+	W	XY	T
5	<i>Artocarpus heterophyllus</i>	+++	W	XY	TBS
6	<i>Artocarpus lokoocha</i>	+++	W	XY	TSU
7	<i>Bauhinia purpurea</i>	+++	W	XY	BSU
8	<i>Bauhinia variegata</i>	+++	W	XY	TBSU
9	<i>Bombax ceiba</i>	++	W	XY	TBS
10	<i>Castanopsis indica</i>	+	S	Y	U
11	<i>Castanopsis tribuloides</i>	++	RW	XY	U
12	<i>Celtis australis</i>	+++	W	XY	SU
13	<i>Dalbergia sissoo</i>	++	S	XY	TBS
14	<i>Dalbergia stipulacea</i>	++	W	XY	TB
15	<i>Dillenia pentagyna</i>	+	W	XY	S
16	<i>Diploknema butyracea</i>	+++	W	XY	SU
17	<i>Erythrina variegata</i>	++	RW	XY	TBS
18	<i>Eugenia jambolana</i>	++	W	Y	TBS
19	<i>Eurya acuminata</i>	+	W	Y	SU
20	<i>Ficus auriculata</i>	+++	W	XY	U
21	<i>Ficus bengalensis</i>	++	RW	XY	TBS
22	<i>Ficus benjamina</i>	+++	W	XY	TBS
23	<i>Ficus cunia</i>	+++	W	XY	SU
24	<i>Ficus glomerata</i>	+++	SW	XY	TB
25	<i>Ficus hispida</i>	++	W	XY	SU
26	<i>Ficus lacor</i>	+++	W	XY	SU
27	<i>Ficus nemoralis</i>	+++	W	XY	U
28	<i>Ficus religisa</i>	++	SW	XY	TBS
29	<i>Garuga pinnata.</i>	++	W	XY	SU
30	<i>Grewia tiliaefolia</i>	+++	W	XY	SU
31	<i>Kydia calycina</i>	++	W	XY	BS
32	<i>Lagerstroemia parviflora</i>	+	W	XY	BS
33	<i>Litsea polyantha</i>	+++	W	XY	BSU
34	<i>Madhuca longifolia</i>	++	W	XY	T
35	<i>Maesa chisia</i>	+	W	Y	SU
36	<i>Mallotus philippinensis</i>	+	W	XY	SU
37	<i>Melia azedarach</i>	++	W	XY	TSU
38	<i>Moringa oleifera</i>	++	W	XY	TS
39	<i>Morus alba</i>	++	W	XY	SU
40	<i>Myrsine capitellata</i>	+	S	Y	SU
41	<i>Persea odoratissima</i>	++	W	XY	SU
42	<i>Premna bengalensis</i>	++	W	XY	SU
43	<i>Prunus cerasoides</i>	++	W	XY	U
44	<i>Schima wallichii</i>	++	S	XY	SU
45	<i>Schleichera oleosa</i>	++	W	XY	BS
46	<i>Shorea robusta</i>	+	W	XY	BS
47	<i>Spondias pinnata</i>	++	W	XY	TBS
48	<i>Tamarindus indica</i>	++	S	XY	TBS
49	<i>Terminalia alata</i>	++	W	XY	SU
50	<i>Terminalia belerica</i>	++	W	XY	BS
51	<i>Terminalia chebula</i>	++	W	XY	BS
52	<i>Terminalia myriocarpa</i>	+	W	XY	BSU
53	<i>Trichilia connaroides</i>	+	W	XY	U
54	<i>Woodfordia fruticosa</i>	+	W	XY	BSU
55	<i>Zizyphus mauratiana</i>	++	RW	XY	TBS

**Quality of fodder:** + + + very good, + + good, + fair. **Feeding season:** S – summer, R – rainy, W – winter; **Preference by Ruminants:** X – Cow and buffalo group, Y – Goat group; **Distribution:** T – Terai, B – Bhabar, S – Siwalik hills, U – Upper hills.

**Table 3:** Chemical composition and nutritive constituents of fodder tree leaves

Species	Dry matter % in fresh matter	% in dry matter			
		Crude protein	Ether extract	Crude fibre	N-free extract
<i>Albizia lebbek</i>	48.61	21.35	3.41	29.25	36.47
<i>Anthocephalus chinensis</i>	20.24	17.51	3.21	28.72	39.70
<i>Artocarpus heterophyllus</i>	31.32	12.56	3.13	21.74	51.33
<i>Bauhinia variegatas</i>	38.43	16.54	2.32	28.81	43.12
<i>Celtis australis</i>	36.51	14.82	3.75	21.28	45.80
<i>Dalbergia sissoo</i>	36.62	17.86	3.52	20.24	48.71
<i>Ficus cunia</i>	38.21	12.35	3.16	24.88	46.35
<i>Ficus glomerata</i>	36.41	14.35	2.62	15.45	54.94
<i>Ficus lacor</i>	29.00	14.62	3.35	22.46	49.70
<i>Garuga pinnata</i>	34.00	11.76	4.24	18.63	52.55
<i>Kydia calycina</i>	43.31	12.62	4.26	18.54	48.95
<i>Madhuca longifolia</i>	19.25	9.73	3.63	19.26	57.71
<i>Melia azedarach</i>	31.32	14.26	3.49	21.45	50.56
<i>Moringa oleifera</i>	29.75	14.42	4.54	18.59	50.13
<i>Morus alba</i>	36.57	20.65	6.45	14.87	43.62
<i>Schleichera oleosa</i>	37.54	11.39	2.39	31.54	46.84
<i>Terminalia alata</i>	37.62	11.57	3.75	18.84	54.57
<i>Terminalia belerica</i>	43.21	13.65	4.35	17.27	55.11
<i>Terminalia chebula</i>	45.43	12.24	3.84	18.35	56.92

**Table 4:** Mineral contents of fodder tree leaves

Species	% in dry matter			
	Total ash	Potassium	Calcium	Phosphorus
<i>Albizia lebbek</i>	9.52	1.86	2.13	0.21
<i>Anthocephalus chinensis</i>	10.86	1.76	2.45	0.24
<i>Artocarpus heterophyllus</i>	11.24	2.23	1.92	0.23
<i>Bauhinia variegata</i>	9.21	1.85	2.87	0.15
<i>Celtis australis</i>	14.35	2.15	4.21	0.18
<i>Dalbergia sissoo</i>	9.67	1.87	2.12	0.19
<i>Ficus cunia</i>	13.86	1.91	3.16	0.14
<i>Ficus glomerata</i>	12.64	1.36	2.21	0.28
<i>Ficus lacor</i>	9.87	1.63	2.15	0.19
<i>Garuga pinnata</i>	12.82	1.76	2.86	0.16
<i>Kydia calycina</i>	15.63	1.46	3.75	0.37
<i>Madhuca longifolia</i>	9.67	1.78	1.61	0.17
<i>Melia azedarach</i>	10.24	1.45	2.87	0.25
<i>Moringa oleifera</i>	12.32	1.16	3.23	0.23
<i>Morus alba</i>	14.41	2.23	3.55	0.32
<i>Schleichera oleosa</i>	7.84	1.45	1.85	0.29
<i>Terminalia alata</i>	11.27	1.12	2.87	0.24
<i>Terminalia belerica</i>	9.62	1.35	2.76	0.22
<i>Terminalia chebula</i>	8.47	1.24	2.51	0.21

#### 4. Discussion

In the present work, the proximate analysis of fodder tree leaves was done. Chemical analysis can indicate the gross feeding potential of a feeding stuff [12]. In case of tree fodders also the chemical composition provides basic information about their feed value but how much nutrients of a fodder plant become available to the feeding animals are determined only after conducting a digestion trial. A fodder plant containing 30% dry matter, 50% organic matter digestibility and less than 10% total ash in the dry matter is generally considered as a good fodder [13]. On the basis of dry matter and total ash content most of the fodder trees could be considered as good fodder. All the analyzed fodder trees have at least more than 30% dry matter except *Anthocephalus chinensis* and *Madhuca longifolia*. The total ash content is also almost 10% or less in most of the fodder species. But few species like *Celtis australis*, *Kydia calycina* and *Morus alba* have exceptionally higher amount of total ash. Higher percentage of acid insoluble ash indicates the poor quality of feed [14].

Higher amount of crude protein, ether extract, N-free extract and lower amount of crude fibre help to examine the quality of the fodders. The crude protein content was higher in all fodder trees except *Madhuca longifolia*. Crude fibre content was exceptionally high in *Schleichera oleosa*, *Albizia lebbek*, *Anthocephalus chinensis* and *Bauhinia variegata*. If the crude fibre content of a plant is high, the digestibility of the fodder may be lower as it contains lignin, a non-nutrient component. The N- free extract is the fraction of total carbohydrates excluding the crude fibre. Thus it includes all the digestible carbohydrates and gives more energy to the animals. Among the minerals, the potassium which plays an important role in nerve- irritation and carbohydrate metabolism was found sufficient in all the fodder trees. The animals require 0.2-0.3% potassium in dry ration [9]. The ratio of calcium and phosphorus should be 2:1 in the feed for the better absorption in the animal body [14]. The calcium content was high in all the fodder trees. Thus, the plants which are rich in dry matter, crude protein, ether extract, N- free extract, and poor in crude fibre and ash content are considered as good fodders.

In the present investigation the quality of the fodders based on their chemical composition was compared with the quality based on farmers' judgment. It was found similar for many fodder plants. However, differences were also seen for some important species. *Dalbergia sissoo* and *Terminalia belerica* were rated as simply "Good" (medium quality) by the local people but these fodder plants have adequate nutritive constituents.

*Albizia lebbek* which is of lowest quality "Fairly good" in farmer's view contains high dry matter, crude protein, ether extract and crude fibre.

It is more appropriate to use the chemical composition as primary criteria and farmers' evaluation as secondary, to assess the quality of fodder plants. On the basis of chemical composition a compilation of good fodders has been made as follows: *Artocarpus heterophyllus*, *Bauhinia variegata*, *Dalbergia sissoo*, *Ficus cunia*, *Ficus glomerata*, *Ficus lacor*, *Garuga pinnata*, *Kydia calycina*, *Melia azedarach*, *Moringa oleifera*, *Morus alba* and *Terminalia belerica*. The fodder species like *Dalbergia sissoo*, *Ficus glomerata*, *Ficus lacor*, *Melia azedarach*, *Moringa oleifera* and *Terminalia belerica* have also been reported as good and nutritious by Gupta *et al.* [15] and Singh [16]. On the basis of local information and chemical composition following plants were assessed as "Very good" fodders: *Artocarpus heterophyllus*, *Bauhinia variegata*, *Ficus cunia*, *Ficus glomerata* and *Ficus lacor*.

## Acknowledgements

The authors are grateful to the authorities of National Academy of Science and Technology for financial support and Institute of Science and Technology, Tribhuvan University for research facilities.

## References

- [1] T.N. Mandal, General survey and biochemical analysis of fodder herbs, shrubs and vines found in Godawari Hill-Forest. M. Sc. thesis, Tribhuvan University, Kathmandu, Nepal (1980).
- [2] J. Stebler, Final report on Jiri Multipurpose Development Project and Quaterly reports on Forest and Pasture Section, Swiss Association for Technical Assistance, Kathmandu, Nepal (1970).
- [3] P. Dutt, Grazing and resources management and improvement, Report submitted to the workshop on Hill Agriculture, Dept. of Agric., Nepal (1978).
- [4] D. Bajrachrya, S.J.B. Rana and A.K. Shrestha, General Survey and biochemical analysis of fodder plants found in Nagarjun Hill Forest of Kathmandu Valley, J. Nat. Hist. Museum, **2** (1-4) (1978) 105-116.
- [5] D. Bajracharya, T.B. Bhattarai, M.R. Dhakal, T.N. Mandal, M.R. Sharma, S. Sitaula and B.K. Vimal, Some feed values for fodder plants from Nepal, Angew. Botanik, **59** (1985) 357-365.
- [6] K.K. Panday, Fodder trees and tree fodder in Nepal, Swiss Development Cooperation, Berue, Switzerland and Swiss Federal Institute of Forestry Research, Birmensdorf, Switzerland (1982).
- [7] K. Peach and M.V. Tracey, Modern method of Plant analysis, Springer-Verlag 1 (1956) 468-486.
- [8] I.S.I., Specification for Compound Feeds for Cattle IS: 2052, Indian Standards Institution, New Delhi (1968).
- [9] L.A. Maynard and J.K. Loosli, Animal Nutrition, 6<sup>th</sup> edn., Mc Graw Hill Book Company, New York (1969).
- [10] M.L. Jackson, Soil chemical analysis, Prentice Hall of India, Pvt. Ltd., New Delhi (1953).
- [11] A.O.A.C., Methods of analysis, Association of official and Analytical Chemist, U.S.D.A- Washington, D.C (1970).
- [12] T.R. Narayan and P.M. Dabadghao, Forage crops of India, Indian Council of Agric. Res., New Delhi (1972).
- [13] K.K. Panday, Importance of fodder trees and tree fodder in Nepal, M. Sc. thesis, Institute of Plant Production, Federal Tech. Univ., Zurich, Switzerland (1975).
- [14] S.K. Ranjhan, Animal nutrition in tropics, 2<sup>nd</sup> edn., Vikas Publishing House Pvt. Ltd., New Delhi (1981).
- [15] P.C Gupta, Randhir Singh, D.C. Sangwan and K. Pradhan, Chemical composition and in vitro nutrient digestibility of some of the tree leaves, Indian Forest, 101, 11 (1975) 674-680.
- [16] R.V. Singh, Fodder trees of India, Oxford and IBH Publishing Co., New Delhi (1982).