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Chemical analysis of fodder climbers found in Sunsari district, Nepal

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Abstract

Altogether 19 fodder climbers were collected with local information for their quality, feeding season and preference by livestock from Sunsari district, Nepal. Fodder climbers were distributed under 15 angiospermic families. Among them, 6 climber species were analyzed for dry matter, crude protein, ether extract, crude fibre, N-free extract, total ash and mineral contents (K, Ca, and P). Dry matter content ranged from 24.12 to 45.43%. Crude protein content showed slight variation. Ether extract ranged from 2.13- 4.23%, while Crude fiber content ranged between 18.62 and 22.52%. N-free extract showed narrow variation in the content while Total ash content exhibited a wide variation ranging from 5.67 to 11.52%. Among the minerals, Phosphorus showed distinct variation in the content from 0.19 to 0.46%. Fodder quality assessed by local people was compared with the result of chemical composition. On the basis of local information and chemical composition, *Hedera nepalensis* and *Hedyotis scandens* were considered as very good fodder climbers.

Key words: Fodder plants, local information, ruminants, nutrient contents, eastern Nepal

Introduction

In Sunsari district, animal husbandry is in practice, especially in Bhabar and Hilly regions. The livestock are used in many agricultural purposes like ploughing, thrashing and transportation within the district. The cows and she-buffalo are husbanded for milk production and goats for meat. Regarding the animal feed, green fodder, consisting of grasses, herbs, shrubs, climbers and tree leaves play an important role in the nutrition of animals. Forest lands are major source of feed for livestock. Fodder collected from the forest provides more than 42% of livestock nutrition in Nepal. About 65 to 75% of the fodder requirements are collected from forests and grasslands in mid-hill (Bajracharya, 1999) and 26-43% in the lower hill of Himalayas (Singh, 1999). Singh and Sundariyal (2009) also reported that in central Himalayan village, fodder trees, shrubs and grazing in the forests are the main sources of the livestock feed. In Sunsari district, people collect the fodders from nearby forests located in Bhabar and Hilly regions.

Several works on fodder plants done in Nepal in connection with pasture and fodder development, livestock development and afforestation programme are cited by Mandal (1980). Stebler (1970) reported the chemical composition of leaves of 13 fodder trees found in the Jiri region. Dutt (1978) 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.* (1978, 1985). Pandey (1982) reported the chemical composition and nutritive constituents of 49 tree fodder found in Nepal. The work on fodder trees of Sunsari district has been published earlier (Mandal & Gautam,

2012). Earlier studies showed that the tree leaves regarded as most valuable tree fodder by the local farmers incidentally also contained the highest amount of crude protein. Farmer's judgment also helps to assess the quality of fodder as it is based on traditional practice. However, it is important to use the chemical composition as primary criteria for the assessment. It has generally been observed that most of the fodder climbers are available during the lean winter months when the green grasses are not available. Further, fodder climbers are equally nutritious as that of pasture legumes. But the works on the climbers are limited. The information on the availability and nutrient contents of fodder climbers from Sunsari district, Nepal, has been documented here. The work was carried out to identify the fodder climbers, analyze the chemical composition of selected species with their nutritive values.

Materials and Methods

Study area

Sunsari district, covering an area of 1265 km^2, 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. There are three distinct regions within the district. The northern part is covered by the hills; middle part is occupied by bhabar region, which is covered by tropical moist forest. The southern part is plain land of tarai. The south tarai and bhabar regions of Sunsari district have tropical climate while the north hilly region has subtropical and temperate climate. The monsoon starts usually in May and lasts till October. The average annual rainfall is 2154.1 mm. The minimum and maximum temperature is 14.2°C and 30.6°C, respectively.

Vegetational zone varies due to climatic and topographic variation. There are three vegetational zones namely tropical, subtropical and temperate in the district in which representative tree species are *Dalbergia sisoo - Shorea robusta* in the tropics, *Schima wallichi - Castanopsis indica* in the subtropics and *Pinus roxburghii - Rhododendron arboreum* in the temperate zone.

Collection of fodder climbers

Fodder climbers were collected from different regions namely tarai, 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 observation on farmers' collection who regularly collects fodder from the forest. The information about local names, quality and availability of fodder climbers were recorded with the help of local experienced farmers. Fodder plants were collected in polythene bags and kept air-tight till the fresh weight was taken. The plants were then allowed to air-dry. They were kept at 60-70°C for 48 h in hot air oven and then the dried samples were kept at 103°C temperature for 4 h to determine dry matter (DM) 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 (CP) content was estimated by multiplying the percentage of nitrogen by a factor 6.25. The percentage of nitrogen was determined by Micro-Kjeldahl technique (Peach & Tracey, 1956). Ether extract (EE - crude fat) was determined by the Soxhlet apparatus. Extraction was done in petroleum ether having boiling point 40C- 60°C (I.S.I., 1968). Crude fibre (CF) content was estimated from the fat free oven dried samples following the method described by I.S.I. (1968). Nitrogen free extract (NFE) was estimated by substraction method. The sum of total crude protein, ether extract, crude fibre and total ash was substracted from 100 (Maynard & Loosli, 1969).

Total ash (TA) content was determined by heating the ground material in a dry crucible on a low flame and then it was muffled at 600°C for 3- 4 h (Peach & Tracey, 1956). Potassium, Calcium and Phosphorus contents were determined from the ashed samples. Potassium was estimated by flame photometric method and Calcium was estimated by titration method as described by Jackson (1953). Estimation of phosphorus was done colorimetrically according to A.O.A.C. (1970).

Results

During the present investigation 19 fodder climbers were recorded from Sunsari district. They have been arranged alphabetically with their local names (Nepali names) and respective families in Table 1. All the fodder climbers fall under 15 families ranging from Apocynaceae to Vitaceae. The families with two species each were Papilionaceae, Moraceae, Smilacaceae and Dioscoreaceae. The families with 1 species were Araliaceae, Apocynaceae, Oleaceae, Caesalpinaceae, Caprifoliaceae, Rubiaceae, Convolvulaceae, Menispermaceae, Rosaceae, Piperaceae, Scrophulariaceae, Urticaceae and Vitaceae. Three climbers were legumes e.g. *Bauhinia vahlii*, *Mucuna macrocarpa* and *Spatholobus parviflorus.*

Table 1. Fodder climbers with their local names (Nepali names) and families from Sunsari district, Nepal.

S.No.	Species	Local name	Family
1	*Bauhinia vahlii* Wight et Arn.	Bhorla	Caesalpinaceae
2	*Dioscorea bulbifera* Linn.	Gitthetarul	Dioscoreaceae
3	*D. deltoidea* Wall ex Kunth	Vyakur	Dioscoreaceae
4	*Ficus sarmentosa* Buch.	Bantimila	Moraceae
5	*F. globosa* Blume.	Thulodudhe	Moraceae
6	*Hedera nepalensis* K. Koch	Pipalpate	Araliaceae
7	*Hedyotis scandens* Roxb. ex D. Don	Biralilaharo	Rubiaceae
8	*Ipomea aquatica* Forsk.	Karmi	Convolvulaceae
9	*Jasminum dispermum* Wall.	Lahare Jai	Oleaceae
10	*Lonicera macrantha* Spreng.	Ban Juhi	Caprifoliaceae
11	*Mucuna macrocarpa* Wall.	Baldhyangro	Papilionaceae
12	*Piper chaba* Hunter	Chabo	Piperaceae
13	*Rubus paniculatus* J.E. Smith	Ghyampeainselu	Rosaceae
14	*Smilax aspera* Linn.	Kukurdaino	Smilacaceae
15	*S. lanceifolia* Roxb.	Chatiwan	Smilacaceae
16	*Spatholobus parviflorus* (Roxb.) O Kruntze	Debrelahara	Papilionaceae
17	*Stephania elegans* Hook.	Batulepate	Menispermaceae
18	*Trachelospermum lucidum* K. Schumann	Dudhilaharo	Apocynaceae
19	*Vitis serrulata* (Roxb.) Planch.	Chadachade	Vitaceae

Local information on fodder climbers

Local information on fodder climbers for their qualities, 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. The fodder climbers are available mainly in the winter season. The

preference of fodder climbers 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.

Table 2. Local information on fodder climbers of Sunsari district, Nepal.

S.No.	Species	Quality	Feeding season	Preference of ruminants	Distribution
1	*Bauhinia vahlii*	+	RW	XY	BS
2	*Dioscorea bulbifera*	+	W	XY	BSU
3	*D. deltoidea*	++	W	XY	SU
4	*Ficus sarmentosa*	+ +	W	XY	SU
5	*F. globosa*	+ +	W	XY	SU
6	*Hedera nepalensis*	+ ++	RW	XY	SU
7	*Hedyotis scandens*	+ ++	W	XY	BSU
8	*Ipomea aquatica*	+ +	SR	X	T
9	*Jasminum dispermum*	+	W	XY	BS
10	*Lonicera macrantha*	+	W	Y	BS
11	*Mucuna macrocarpa*	++	W	XY	U
12	*Piper chaba*	+	SW	XY	SU
13	*Rubus paniculatus*	+ +	W	XY	U
14	*Smilax aspera*	+ +	WY	XY	BSU
15	*S. lanceifolia*	++	WY	XY	BSU
16	*Spatholobus parviflorus*	+ ++	W	XY	BS
17	*Stephania elegans*	+ +	W	XY	BSU
18	*Trachelospermum lucidum*	++	RW	XY	BSU
19	*Vitis serrulata*	+ ++	W	XY	SU

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

Chemical analysis of fodder climbers

Altogether, leaves of 6 important climbers 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.

Table 3. Chemical composition and nutritive constituents of fodder climbers.

Species	Dry matter % in fresh matter	% dry matter			
		Crude protein	Ether extract	Crude fibre	N-free extract
Hedera nepalensis	42.32	10.12	3.87	18.62	56.05
Hedyotis scandens	28.45	10.64	3.42	19.61	54.81
Ipomea aquatic	24.12	11.24	4.23	20.63	54.14
Lonicera macrantha	45.43	12.56	2.13	19.57	54.21
Smilax aspera	35.42	11.63	3.75	21.42	56.99
S. lanceifolia	33.63	12.35	3.41	22.52	56.05

Table 4. Mineral contents in fodder climbers.

Species	% dry matter			
	Total ash	**Potassium**	**Calcium**	**Phosphorus**
Hedera nepalensis	11.34	1.23	3.26	0.46
Hedyotis scandens	11.52	1.54	2.43	0.34
Ipomea aquatic	9.76	2.62	2.74	0.26
Lonicera macrantha	9.53	2.25	2.18	0.32
Smilax aspera	6.21	1.24	2.72	0.19
S. lanceifolia	5.67	1.52	2.14	0.26

Dry matter content ranged from 24.12-45.43%, which was minimum in *Ipomea aquatica* and maximum in *Lonicera macrantha*. Crude protein content showed slight variation in all the examined species and ranged from 10.12-12.56%. Ether extract ranged from 2.13-4.23% among the fodder climbers. Lowest value was observed in *Lonicera macrantha* and highest in *Ipomea aquatica*. Crude fibre content ranged from 18.62-22.52%, which was minimum in *Hedera nepalensis* and maximum in *Smilax lanceifolia*.

Nitrogen - free extract showed narrow variation in the content ranging from 54.14-56.99%. Total ash content among fodder climbers ranged from 5.67-11.52%, with minimum value in *Smilax lanceifolia* and maximum in *Hedyotis scandens*. In the minerals, Potassium content ranged from 1.23-2.62%, with the lowest value in *Hedera nepalensis* and highest value in *Ipomea aquatica*. Calcium content ranged from 2.14-3.26%, the lowest value was observed in *Smilax lanceifolia* and highest in *Hedera nepalensis*. Phosphorus content ranged from 0.19-0.46%, *Smilax aspera* had lowest value and *Hedera nepalensis* had highest value.

Discussion

Local information suggested that some of the climbers are of very good quality fodders. Fodder climbers are available mainly during the lean winter period when the green grasses are not available. Almost all climbers are preferred by both cow and buffalo group and goat group. As the forests are the main sources of livestock feed in the hills, it is important to manage these biodiversity for sustainable use (Maren & Vetaas, 2007). Regarding the management and sustainable use of forest resources, Pandey (2011) suggested that community forest land should be taken for the use of fuel and fodder need and the natural forest land should be kept as protected and reserved forest so that the stability of the terrain could be maintained and fragility could be reduced.

Chemical analysis of fodder climbers was done to compare with the local information and an attempt has been made to recognize the nutritive fodder climbers. Chemical analysis can indicate the gross feeding potential of a feeding stuff (Narayan & Dabadghao, 1972). How much nutrients of a fodder plant become available to feeding animals are determined only after conducting a digestion trial. Hence, a complete idea about the nutritive value of fodder plant can be obtained only after the determination of organic matter digestibility. In absence of this value, farmers' judgement which is based on long traditional practice of feeding the animals has been taken into consideration to assess the quality of fodders.

A fodder plant containing more than 30% dry matter (DM), 50% organic matter digestibility and less than 10% total ash (TA) in the dry matter is generally considered as a good fodder

(Pandey, 1975). A higher percentage of acid insoluble ash indicates the poor quality of feed (Ranjhan, 1981). According to these criteria, all the fodder climbers mentioned in Tables 3 and 4 can be considered as good fodder. Although, *Ipomea aquatica* contained minimum DM (24.12%) and *Smilax lanceifolia* has minimum ash content (5.67%).

Higher amount of crude protein, ether extract, N-free extract and lower amount of crude fibre also help to qualify the fodders. The crude protein content was more than 10% in all species. Crude fibre content was lower in *Hedera nepalensis*, *Lonicera macrantha* and *Hedyotis scandens* while it was higher in *Smilax aspera* and *S. lanceifolia*. The ether extract content was lower (less than 5% of DM) while N- free extract (fraction of total carbohydrates excluding the crude fibre) was higher (more than 54% in DM) in all fodder climbers. Among the minerals, potassium was found sufficient in all the climbers. The animals require 0.2-0.3% potassium in dry ration (Maynard & Loosli, 1969). The ratio of calcium and phosphorus should be 2:1 in the feed for the better absorption in animal body (Ranjhan, 1981). The calcium content was more than 2% in DM in all the climbers. 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 *Hedera nepalensis* and *Hedyotis scandens*. However, differences were seen for some important species. *Lonicera macrantha* was rated as fair quality, by local people but this plant contained adequate nutritive constituents. *Smilax aspera* and *S. lanceifolia* were assessed as 'good' quality fodder by the local people, had higher DM, CP, NFE and lower TA. However, these plants were higher in CF contents which lower the quality. Protein contents in all fodder climbers were higher than herbs and comparable with fodder tree leaves reported by Mandal (1980) and Mandal and Gautam (2012). Similarly, it was also comparable with the protein content of pasture legumes (Whyte *e. al.*, 1953).

It is more important to use the chemical composition as primary criteria and farmers' evaluation as secondary, to assess the quality of fodder plants. On this basis *Lonicera macrantha* can be considered as good fodder climber. Further, on the basis of both local information and chemical composition *Hedera nepalensis* and *Hedyotis scandens* were considered as very good fodder climbers.

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