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Effect of seasonal variation in biochemical composition of leaves of fodder trees prevalent in the mid-hill region of Himachal Pradesh

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Abstract

Fodder tree leaves from eight different species prevalent in mid-hill region of Himachal Pradesh were collected at two month intervals throughout the year to assess seasonal variation in nutritional profile. *Arratocarpus lakoocha* (22.88%) exhibited highest crude protein content during March while lowest value was observed during January for *Albizzia chinensis* (5.83%). In *Albizzia chinensis,* crude fiber (34.73%) was highest during January, while *Morus alba* (18.0%) exhibited least content during November. In *Morus alba,* ash content (16.90%) was highest during September, whereas *Albizzia lebbek* had the lowest ash content (4.10%) during the month of January. *Arratocarpus lakoocha* exhibited minimum ether extract (1.00%) during September and January whereas, maximum level was observed during the month of May and July in *Albizzia lebbek* (4.90%). Cell content was highest in *Arratocarpus lakoocha* (61.00%) during May, whereas, least values were observed during the month of September and November in *Bambusa arundinacea* (30.20%). *Bambusa arundinacea* exhibited maximum neutral detergent fiber (70.20%) and acid detergent fiber (57.80%) during the month of January, while *Morus alba* exhibited minimum level of neutral detergent fiber (53.00%) and acid detergent fiber (34.00%) during March. In *Celtis australis* hemi-cellulose (25.60%) was higher during September, while least content was recorded during the month of July in *Grewia oppositifolia* (8.00%). It was observed that the NDF, ADF and hemicellulose contents were increased, while crude protein, ether extract, ash cell contents were decreased in advancing months. The study revealed that *Morus alba* and *Grewia oppsitifolia* are excellent source of fodder in mid Himalayan region which retained appreciable amount of nutrients in leaves.

Keywords: Mid-Himalayas, Nutritional profile, Seasonal variation, Tree foliage

Abbreviations: ADF: Acid detergent fiber; **CF:** Crude fiber; **CP:** Crude protein; **HC:** Hemicellulose; **NDF:** Neutral detergent fiber;

Introduction

Fodder trees have wide prevalence in the mid hill areas of Himalayan region. Many of them are long-lived, require low maintenance and enhance the sustainability of farming systems (Rawat and Subhas, 2011). They have tremendous potential for alleviating acute feed shortages when all other fodder sources have been exhausted (Katoch, 2009; Verma *et al.,* 2015; Kaushal *et al.,* 2016; Sahoo *et al.,* 2016; Nag *et al.,* 2017). As compared to conventional grasses, tree foliages have good proportions of nutrients which keep intestinal microflora active for digesting cellulosic biomasses (Shelton, 2004; Katoch *et al.*, 2012; Singh and Todaria, 2012; Singh *et al.,* 2015). Furthermore, they can also help to bridge over the wider gap between demand and supply of nutrients in feeding stuffs. The tree foliage contributes adequate amount of vitamins, minerals and dietary nitrogen to complement deficiencies in the basal fed resource (Katoch *et al.,* 2013). The quality of ruminant diet in hilly region depends upon the plant species present in the range, forage availability and nutritive value of forages (Cherney and Volenec, 1992; Katoch *et al.,* 2005). The nutritive value of forages relies on the level of nutrients, their intake, digestibility and partitioning of metabolized products to various tissues. However, the nutritional value of forages also varies with the seasonal variations in growing area which affect the performance of the livestock. Blakely and Blade (1994) asserted that climatic variations in growing area affect the nutrient composition of forage species. Therefore, seasonal variations have been greatly emphasized as the main determinants of nutritive quality of forages. The knowledge of level of nutrients in foliage at different time intervals during a growth season can be used as indicator for determining appropriate lopping period for a particular tree species in a defined agro-climatic region (Verma and Mishra, 1999; Dongmeza *et al.,* 2009). Hence, this investigation was undertaken to study the effect of seasonal variations on nutritional composition of common forage trees of mid Himalayan region for selecting a potentially suitable fodder tree to be fed at particular season.

Materials and Methods

***Study site and materials*:** The study on the effect of seasonal variation on nutritional composition of leaves was carried out in eight fodder tree species prevalent in mid- hill region of Himachal Pradesh during the year 2013 and 2014. Foliages of Kachnar *(Bauhinia variegata),* Deon (*Arratocarpus lakoocha*), Bamboo (*Bambusa arundinacea*), Khirak *(Celtis australis),* Toot (*Morus alba*), Siras (*Albizzia lebbek*), Biul (*Grewia oppsitifolia*), and Oee (*Albizzia chinensis*) were sampled periodically at two-month intervals starting from the month of March to January. The samples were air dried and ground in Willey mill to pass through the 2-mm mesh. The grounded samples were then packed in air tight bags for analysis of biochemical parameters.

***Analytical methods*:** The crude protein, crude fiber, ash, neutral detergent fiber, acid detergent fiber, hemicellulose and cell contents were determined according to the standard procedures of (AOAC, 1970). The data were statistically analyzed by the method given by Panse and Sukhatme (1985).

Results and Discussion

Quality nutrients and cell contents: The study revealed remarkable variation in quality nutritional constituents in fodder tree leaves throughout the year. During March, highest value of crude protein was observed in *Arratocarpus lakoocha* (22.88%) followed by *Albizzia lebbek* (19.13%) and *Bambusa arundinacea* (18.81%), whereas lower value was observed in *Grewia oppositifolia* (8.75%; Table 1). In May, *Morus alba* revealed significant increase in CP content (22.77%). The CP (%) was highest in *Morus alba* (20.41%) followed by *Bauhinia variegata* (16.04 %) during the month of July whereas low CP (%) was observed in *Albizzia chinensis* (10.49%). In September, the crude protein content ranged from 7.49% in *Albizzia chinensis* to 14.58% in *Grewia oppositifolia*. The highest CP content during November was recorded for *Morus alba* (12.83%), whereas *Albizzia chinensis* had low protein content (6.56%) in that particular month. The least value of CP content was recorded in all tree foliages during January, as compared to other months of the year. The least value of CP was observed in *Albizzia chinensis* (5.83%), however, *Bambusa arundinacea* and *Celtis australis* still retained CP content up to 10.49 and 10.70%, respectively. Among eight fodder trees under study, highest crude protein content was recorded in March for *Arratocarpus lakoocha* (22.88%) and least was observed during January in *Albizzia chinensis* (5.83%).

Table 1. Seasonal variation in CP (% DM basis) of common fodder trees of mid-hill Himalayas

Scientific name	Local name	Month of harvesting					
		March	May	July	Sept	Nov	Jan
Bauhinia variegate	Kachnar	18.08±0.03	16.62±0.11	16.04±0.08	11.66±0.08	11.08±0.14	10.20±0.08
Grewia oppositifolia	Biul	18.75±0.05	18.92±0.04	17.79±0.15	14.58±0.15	11.66±0.11	9.50±0.13
Albizzia lebbek	Siras	19.13±0.07	13.76±0.09	14.34±0.14	11.95±0.09	9.33±0.08	8.80±0.12
Celtis australis	Khirak	13.85±0.04	16.53±0.08	15.60±0.13	13.64±0.15	10.64±0.07	10.70±0.04
Bambusa arundinacea	Bamboo	18.81±0.08	16.01±0.13	15.28±0.04	12.10±0.14	10.40±0.13	10.49±0.05
Morus alba	Toot	14.93±0.06	22.77±0.11	20.41±0.15	13.76±0.07	12.83±0.16	9.04±0.08
Arrtocarpus lakoocha	Deon	22.88±0.08	13.50±0.14	14.52±0.15	13.70±0.05	11.95±0.07	8.45±0.05
Albizzia chinensis	Oee	13.41±0.12	10.64±0.16	10.49±0.12	7.49±0.09	6.56±0.08	5.83±0.06

Table 2. Seasonal variation in ether extract (%) of common fodder trees of mid-hill Himalayas

Scientific name	Local name	Month of harvesting					
		March	May	July	Sept	Nov	Jan
Bauhinia variegate	Kachnar	2.62±0.09	3.50±0.13	4.50±0.12	3.50±0.13	3.00±0.12	2.70±0.06
Grewia oppositifolia	Biul	3.07±0.12	3.70±0.19	3.79±0.24	4.00±0.11	2.50±0.14	2.60±0.09
Albizzia lebbek	Siras	4.70±0.13	4.90±0.36	4.90±0.15	3.60±0.07	3.00±0.51	3.00±0.19
Celtis australis	Khirak	1.97±0.18	1.90±0.24	2.00±0.12	1.50±0.09	1.30±0.17	1.30±0.09
Bambusa arundinacea	Bamboo	3.50±0.23	3.80±0.22	3.40±0.32	2.30±0.11	2.30±0.08	1.80±0.05
Morus alba	Toot	4.30±0.15	4.50±0.08	4.80±0.22	3.10±0.21	3.00±0.23	2.60±0.12
Arrtocarpus lakoocha	Deon	1.50±0.16	1.60±0.07	1.30±0.12	1.00± 0.09	1.10±0.09	1.00±0.02
Albizzia chinensis	Oee	2.70±0.13	3.50±0.05	3.00±0.19	3.00± 0.21	1.20±0.03	1.30±0.08

Ether extract (crude fat) represents the fat and fat-soluble components in forages. During the month of March, maximum crude fat was observed in *Albizzia lebbek* (4.70%) followed by *Morus alba* (4.30%) and *Bambusa arundinacea* (3.50%) whereas minimum value of crude fat was observed in *Arratocarpus lakoocha* (1.50%; Table 2). The crude fat content was highest in *Albizzia lebbek* (4.90%) and lowest in *Arratocarpus lakoocha* (1.30%) during July. In September, the crude fat content ranged from 1.00% in *Arratocarpus lakoocha* to 4.00% in *Grewia oppsitifolia*. The highest crude fat content during November was recorded for *Bauhinia variegata*, *Morus alba* and *Albizzia lebbek* (3.00%), whereas, *Arratocarpus lakoocha* had the least value (1.10%). During January, the crude fat content in *Albizzia lebbek* was highest (3.0%) while *Arratocarpus lakoocha* had the lowest value (1.00%). The study revealed that during the year, crude fat content were highest in month of May and July in *Albizzia lebbek* (4.90%) and lowest in *Arratocarpus lakoocha* (1.0%) during September and January.

During March, highest ash content was recorded for *Morus alba* (9.40%) followed by *Arratocarpus lakoocha* (7.60%), *Grewia oppsitifolia* (7.60%) and *Celtis australis* (6.90%), whereas minimum ash content was for *Albizzia chinensis* (4.50%). *Arratocarpus lakoocha* (10.12%) recorded significant increase in ash content during May (Table 3). The ash content was highest in *Arratocarpus lakoocha* (12.50%) and lowest in *Bauhinia variegata* (6.00%) during the month of July. The ash content ranged from 6.50% in *Bauhinia variegata* to 16.90% in *Morus alba* in September while in November the ash content varied from 4.70% in *Albizzia lebbek* to 14.40% in *Morus alba.* In January, *Arratocarpus lakoocha* had the highest ash content (9.70%). The study revealed that *Morus alba* had the highest ash content (16.90%) during the month of September. The least value of was observed during the month of January in *Albizzia lebbek* (4.10%).

The cell content of foliage from fodder trees at different clipping intervals was also recorded by subtracting NDF content from 100. During March, highest cell content was observed in *Morus alba* (47.00%) followed by *Grewia oppsitifolia* (45.00%), *Bauhinia variegata* and *Albizzia lebbek* (42.00%) whereas minimum value were observed in *Bambusa arundinacea* (34.20%). *Arratocarpus lakoocha* revealed significant increase in cell content up to 61.00% during the month of May. The cell content was recorded highest in *Morus alba* (55.40%) and lowest in *Bambusa arundinacea* (32.00%) during the month of July. The highest cell content during the month of November was recorded in *Morus alba* (42.60%) whereas *Bambusa arundinacea* had the least value (30.20%). During January, *Morus alba* (40.20%) had the

Table 3. Seasonal variation in ash content (%) of common fodder trees of mid-hill Himalayas

Scientific name	Local name	Month of harvesting					
		March	May	July	Sept	Nov	Jan
Bauhinia variegate	Kachnar	5.40±0.11	6.00±0.10	6.00±0.08	6.50±0.14	6.10±0.09	6.00±0.54
Grewia oppositifolia	Biul	7.60±0.09	7.70±0.16	9.60±0.15	8.30±0.19	8.40±0.11	8.20±0.75
Albizzia lebbek	Siras	5.70±0.28	7.30±0.09	8.40±0.16	8.00±0.09	4.70±0.23	4.10±0.63
Celtis australis	Khirak	6.90±0.12	8.70±0.12	9.60±0.10	6.70±0.02	6.70±0.12	6.00±0.17
Bambusa arundinacea	Bamboo	5.40±0.20	7.80±0.07	10.60±0.11	10.20±0.09	9.30±0.19	6.70±0.38
Morus alba	Toot	9.40±0.18	9.90±0.05	11.40±0.08	16.90±0.11	14.40±0.20	6.80±0.72
Arrtocarpus lakoocha	Deon	7.60±0.19	10.12±0.11	12.50±0.85	10.60±0.17	13.00±1.09	9.70±0.86
Albizzia chinensis	Oee	4.50±0.08	5.60±0.12	7.80±0.10	7.90±0.13	6.40±0.12	6.40±0.17

Table 4. Seasonal variation in CF (%) of common fodder trees of mid-hill Himalayas

Scientific name	Local name	Month of harvesting					
		March	May	July	Sept	Nov	Jan
Bauhinia variegate	Kachnar	18.33±0.05	20.42±0.11	24.18±0.13	26.04±0.14	27.06 ±0.11	32.38±0.46
Grewia oppositifolia	Biul	15.96±0.09	16.13±0.08	18.23±0.11	19.08±0.13	24.20± 0.42	27.00±0.56
Albizzia lebbek	Siras	18.58±0.11	18.90±0.15	21.10±0.08	24.79±0.14	27.56± 0.31	32.50±0.75
Celtis australis	Khirak	16.90±0.12	17.80±0.09	19.53±0.16	22.73±0.42	23.70 ±0.21	26.36±1.15
Bambusa arundinacea	Bamboo	24.47±0.17	26.40±0.04	28.80±0.15	30.94±0.23	31.53± 0.53	31.73±1.12
Morus alba	Toot	13.30±0.13	14.73±0.12	15.70±0.09	16.66±0.21	18.00± 0.45	20.03±1.45
Arrtocarpus lakoocha	Deon	21.16±0.09	21.23±0.08	23.00±0.18	25.46±0.15	27.90± 0.78	29.83±1.25
Albizzia chinensis	Oee	25.16±0.08	26.46±0.07	29.43±0.15	30.83±0.22	30.50± 0.87	34.73±1.23

highest cell content. The results of the study revealed that the cell content were highest in *Arratocarpus lakoocha* (61.00%) during the month of May, whereas the least values were observed during the month of September and November in *Bambusa arundinacea* (30.20%).

Ryan and Bormann (1982) reported that during spring season higher level of CP was needed for initial leaf growth and stem elongation. At these initial stages of development, growth is accompanied by a high mitotic activity due to cellular growth and a strong demand for nutrients. Thereafter, the quantity of this element decreased, particularly during the autumn. A similar pattern of variation in CP content in relation to the season was observed in our study. During the month of March, CP content was high in *Arratocarpus lakoocha* (22.88%) and this level gradually decreased with the maturity advances. *Grewia oppositifolia* also revealed decrease in CP content during September up to 14.58% and *Celtis australis* had reduction up to 10.70% during the month of January. As the crude protein content decreased with the plant maturity, the fiber content generally shows an increased level with corresponding reduction in cell contents. The findings in this study were also in conformity to Ba *et al*. (2005) and Srivastava *et al*. (2006) who reported a high CP content in *Morus alba* up to 30.91%. Therefore mulberry leaves have a high potential as a protein-rich forage supplement for animal production (Benavides, 2000). Subba *et al*. (1995) reported that a higher proportion of the CP in the fodder tree leaves is actually in available form to ruminant animals with a potential to sustain better productivity.

Fibrous nutrients in tree foliages: Crude fiber (CF) is the insoluble fraction that made up of plant structural carbohydrates such as cellulose and hemicellulose also contains some amounts of lignin. CF content is inversely related to fodder quality. During March, maximum CF content was observed in *Albizzia chinensis* (25.16%) followed by *Bambusa arundinacea* (24.47%) and *Arratocarpus lakoocha* (21.16%) whereas minimum CF content was observed in *Morus alba* (13.30%; Table 4). In the month of May, *Albizzia chinensis* revealed significant increase in CF content (26.46%) whereas *Morus alba* was still observed with moderate levels of CF (14.73%). The CF value was highest in *Albizzia chinensis* (29.43%) and lowest in *Morus alba* (15.70%) during the month of July. In September, CF content ranged from 16.66 to 30.94% in *Morus alba* and *Bambusa arundinacea*, respectively. During the month of November, the highest crude fiber content was recorded in *Bambusa arundinacea* (31.53%), whereas, *Morus alba* revealed the least value of CF (18.0%). In winters, during the month

Table 5. Seasonal variation in NDF (%) of common fodder trees of mid-hill Himalayas

Scientific name	Local name	Month of harvesting					
		March	May	July	Sept	Nov	Jan
Bauhinia variegate	Kachnar	58.00±3.09	61.00±2.12	63.00±1.56	66.60±1.23	67.00±1.16	67.00±1.88
Grewia oppositifolia	Biul	55.00±2.16	56.60±2.15	59.40±2.17	59.80±2.63	62.00±2.56	62.60±1.69
Albizzia lebbek	Siras	58.00±2.13	59.00±1.96	63.00±3.01	63.40±2.96	64.00±1.45	65.00±1.87
Celtis australis	Khirak	60.00±3.03	60.60±3.12	63.40±2.23	65.40±3.15	65.80±2.14	66.00±1.12
Bambusa arundinacea	Bamboo	63.80±1.19	64.60±4.17	68.00±4.77	69.80±1.18	69.80±1.25	70.20±3.56
Morus alba	Toot	53.00±2.05	53.80±3.19	54.60±3.12	54.80±3.56	57.40±2.23	59.80±4.74
Arrtocarpus lakoocha	Deon	58.60±1.12	59.00±4.12	59.80±3.56	62.60±2.23	63.40±1.89	63.80±2.23
Albizzia chinensis	Oee	60.20±2.19	63.20±3.45	64.60±1.58	65.00±4.12	69.40±2.21	69.60±3.16

Table 6. Seasonal variation in ADF (%) of common fodder trees of mid-hill Himalayas

Scientific name	Local name	Month of harvesting					
		March	May	July	Sept	Nov	Jan
Bauhinia variegate	Kachnar	47.20±1.56	49.40±1.89	51.60±1.11	52.00±1.43	54.60±0.89	56.00±2.22
Grewia oppositifolia	Biul	38.00±2.12	39.60±1.45	41.40±1.10	46.00±1.97	49.40±0.68	51.20±0.89
Albizzia lebbek	Siras	37.60±1.89	39.00±0.99	40.00±1.01	49.40±1.56	51.80±0.78	52.20±1.08
Celtis australis	Khirak	37.00±1.25	37.40±1.56	38.60±1.18	39.80±0.86	45.40±1.11	48.40±1.85
Bambusa arundinacea	Bamboo	40.60±0.89	43.00±1.78	46.20±0.98	48.40±0.85	51.80±1.45	57.80±0.97
Morus alba	Toot	34.00±1.25	34.60±0.12	37.80±0.85	38.60±0.78	41.40±1.23	46.20±0.89
Arrtocarpus lakoocha	Deon	37.20±0.79	39.60±0.97	40.60±0.78	43.40±1.16	45.00±2.45	49.20±1.82
Albizzia chinensis	Oee	37.80±0.56	42.00±0.12	47.20±1.08	48.60±1.23	50.60±1.87	51.00±2.21

of January, the CF content in *Albizzia chinensis* (34.73%) was significantly higher than *Morus alba* (20.03%). The overall comparative analysis of eight fodder trees during different months revealed highest CF content during January in *Albizzia chinensis* (34.73%), whereas the least value of CF was observed in March for *Morus alba* (13.30%).

In March, highest NDF content was observed for *Bambusa arundinacea* (63.80%) followed by *Albizzia chinensis* (60.20%) and *Celtis australis* (60.00%) whereas, lowest value was observed in *Morus alba* (53.00%; Table 5). The NDF content was highest in *Bambusa arundinacea* (68.00%) and lowest in *Morus alba* (54.60%) during the month of July. In September, the NDF content ranged from (54.80%) in *Morus alba* to (69.80%) in *Bambusa arundinacea*. The highest NDF content in November was observed in *Bambusa arundinacea* (69.80%), whereas *Morus alba* revealed the least value (57.80%). During January, the NDF content was highest in *Bambusa arundinacea* (70.20%) and lowest in *Morus alba* (59.80%). The study revealed that during the year the highest NDF content was present in *Bambusa arundinacea* (70.20%) during January, whereas the least content was observed in month of March for *Morus alba* (53.00%).

ADF content represents the least digestible part of forage. It includes cellulose, lignin, silica, insoluble forms of nitrogen but excludes hemicellulose. Lower the ADF content, higher the digestibility and therefore better quality of forage. During March, highest ADF content was observed for *Bauhinia variegata* (47.20%) followed by *Bambusa arundinacea* (40.60%) and *Grewia oppsitifolia* (38.00%), whereas minimum value was observed in *Morus alba* (34.00%; Table 6). *Bauhinia variegata* (49.40%) revealed increase in ADF content during the month of May. In July, the ADF content was highest in *Bauhinia variegata* (51.60%) and lowest in *Morus alba* (37.80%). During September, the ADF content ranged from 38.60% in *Morus alba* to 52.00% in *Bauhinia variegata*. During the month of November, the highest ADF content was recorded in *Bauhinia variegata* (54.60%), whereas, *Morus alba* had the least value (41.40%). In January, the ADF content was lowest in *Morus alba* (46.20%). During the whole year, the highest ADF content was recorded in *Bambusa arundinacea* (57.80%) during January and the lowest content were observed during March in *Morus alba* (34.00%).

Hemi-cellulose (HC) is the one of the principal constituent of plant cell walls and refers to various polysaccharides which are tightly associated with the surface of the cellulose microfibril. The difference between NDF and ADF content gives hemicellulose content and it is also the partially digestible component of forage. In March, *Bambusa arundinacea* (23.20%) followed by *Celtis australis* (23.00%) and *Albizzia chinensis* (22.40%) revealed comparatively higher values of HC, whereas lower value was observed in *Bauhinia variegata* (10.80%). The HC content was highest in *Celtis australis* (24.60%) and lowest in *Grewia oppsitifolia* (8.00%) during the month of July. During September and November, *Celtis australis* had highest value of HC content. During January, *Albizzia chinensis* recorded highest value of HC content (18.60%) whereas, *Bauhinia variegate* had the least value (11.00%). Throughout the year, the highest HC content was observed during the month of September in *Celtis australis* (25.60%) and the least value was observed in *Grewia oppositifolia* (8.00%) during July.

The significant effect of season on the nutrient composition of the fodder trees in this study was in conformity with the report of Abusuwar *et al.* (2010), who observed that the fodder leaves at younger stage had high crude protein content and low fiber content but with advancement in maturity quality nutrient contents were decreased and fibrous nutrient contents were increased. The high level of ash content in *Morus alba* (16.90%) revealed that inorganic elements were substantial in fodder trees (McClements and Decker, 2009). It is well established that a low content of poorly digestible cell wall components and a higher level of ether extract and ash content are indicators of a good forage quality (Van Soest, 1967). Similar results were also reported earlier by many workers (Papachristou *et al*., 1999; Khanal and Subba, 2001) as usually the progress in maturity was reflected in a pronounced development of the supporting tissues and a slower relative growth rate of the metabolic tissues, resulting in increased contents of all the cell wall components with a decrease in CP content. As expected, NDF, ADF and hemi cellulose contents showed an opposite trend to that observed for CP.

The leaves of *Morus alba* were found as a good fodder resource for ruminant animals due to high level of crude protein and high digestibility of nutrients and energy (Singh and Makkar, 2002; Muhammad *et al.,* 2009; Vu *et al.,* 2011). The results from our study also revealed that *Morus alba* leaves are rich in CP and poor in fibrous nutrients. These combinations make it a perfect fodder supplement and become more easily available for the degradation by rumen microbes. *Morus alba* was recommended as best fodder tree during March to April and September to December due to its high potential as a protein-rich forage supplement to be used in diets for livestock. However, during May to August *Grewia oppositifolia* was observed as excellent forage as it contains balanced amount of crude protein, minimum fiber content and other constituents. The leaves from the other fodder tree species under study could also be used in appropriate season when they possess high nutrient contents.

Conclusion

The present study showed remarkable changes in the nutrient profile of eight fodder trees which were greatly influenced by seasonal variations in the mid-Himalayan region. Generally, for better animal health and productivity, higher CP, ash, ether extract and cell contents and lower CF, NDF, ADF and HC contents are recommended for a fodder to be used. *Morus alba* retained maximum nutritive value from March to April and September to December and was considered as a good tree fodder. While *Grewia oppositifolia* was found useful for the remaining months of a year in meeting the nutritional requirements of the livestock for better animal productivity.

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