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Macro and micro elemental concentrations in some locally available tree fodder of Sikkim

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Das and De (2001) reported that tree fodder constitute 25 to 60% green fodder fed to the livestock in Sikkim and most of these tree fodders contain 10 to 14.5% CP and 40 to 45% NDF, which can meet the maintenance requirement of livestock. Chatterjee *et al.* (2005) studied the comparative chemical composition of some locally available high altitude tree fodders of Sikkim. There is paucity of data on the mineral status of these tree fodders. In the present study, attempts have been made to evaluate the comparative macro and micro element status of 21 locally available tree fodder of Sikkim, commonly used for feeding cattle, goat and sheep.

Samples of 21 commonly available tree fodder species were collected during different season from different areas of Sikkim and then pooled. The samples were dried, ground and processed to make its acid extract as per Heckman (1967) and AOAC (1990). Dried ground fodder sample (2 g) was placed in a porcelain crucible and ashed in muffle furnace at 550°C. The sample was cooled and 10 ml of 3N HCl was added, covered with a watch glass and boiled gently for 10 min. After cooling, the sample was filtered and diluted with deionized water to 100 ml in volumetric flask. The concentration of Ca, Mg, Na, K, Cu, Co, Fe, Mn and Zn were determined following the standard procedure through atomic absorption spectrophotometer. The standard for each element was prepared using the separate stock standards. For determination of calcium, 1% lanthanum was added to standards and samples. A reagent blank was also made. Phosphorus (P) was estimated by Alkali metric ammonium molybdophosphate method (AOAC 1990).

The macro and micro element concentration in different tree fodders are presented in Tables 1 and 2. The mean concentration (mg/kg DM) of different macro and micro element in tree fodder analyzed in this study were 0.284 ± 0.007, 0.195 ± 0.027, 0.058 ± 0.002, 0.029 ± 0.002, 1.55 ± 0.16, 54.85 ± 10.64, 39.13 ± 3.47, 227.89 ± 47.0, 395.49 ± 46.75 and 0.39 ± 0.08 respectively for calcium, phosphorus, magnesium, sodium, potassium, copper, zinc, manganese, iron and cobalt.

The calcium concentration (% DM) varied from 0.16 in Katush to 0.31 in chiple, kamle and khasre. Except katush, all the samples were having calcium content in the range between 0.26 and 0.31%, close to the critical level (< 0.30%, McDowell and Conrad 1977). The phosphorus concentration (% DM) ranged from 0.08 in gineri to 0.48 in chiple and Rubber. In case of phosphorus, 18 samples were below critical level (<0.35%, McDowell and Conrad 1977). The magnesium (% DM) was more or less similar in almost all the tree leaves ranging narrowly from 0.04 in jhingani to 0.07 in chiple, gayo, kamle, khasre, lali, and sial phusre. The potassium concentration (% DM) ranged from 0.38 in pipli to 2.69 in Khasre. The highest sodium concentration was found in chiple, the value being 0.06%. Out of 21 samples, 8 samples contained only 0.02% of sodium.

The data revealed that all the tree leaves were richer in potassium in comparison to other macro elements analyzed here. Almost all the tree fodder screened, had adequate levels of potassium as compared to its requirement of 0.60 to 0.80% (Underwood 1981).Thomson (1972) described potassium as useful but not critical nutrient due to its abundance in common ration, pasture and plant materials. Singh *et al.* (2002) reported the potassium in common forages to be 0.40 to 1.92%, the range is quite similar to our observation for tree fodder. In contrary, sodium was comparatively lower in most of the tree fodder. All the tree fodders contained below recommended levels (0.08 - 0.10%) of sodium for livestock (NRC 1989). Berger (1990) reported poor sodium content in most of the vegetative foodstuffs. Singh *et al.* (2002) also reported the sodium content to be many fold lower than

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Table 1. Macro element concentration in some tree fodder of Sikkim (% of DM)

Common name	Scientific name	Calcium %	Phosphorus%	Magnesium%	Sodium%	Potassium%
Bat	*Ficus bengalensis*	0.30	0.12	0.06	0.03	1.29
Barhar	*Artocarpus lakoocha*	0.29	0.12	0.05	0.02	1.03
Chiple	*Reevesia pubescens*	0.31	0.48	0.07	0.06	2.19
Dudhilo	*Ficus nemoralis*	0.28	0.13	0.06	0.04	2.48
Gayo	*Bridelia retusa*	0.29	0.14	0.07	0.02	1.17
Gineri	*Premna mucronata*	0.27	0.08	0.06	0.03	2.36
Jhingani	*Eurya japonica*	0.27	0.11	0.04	0.02	0.47
Kabra	*Ficus infectoria*	0.28	0.46	0.06	0.03	1.69
Kamle	*Bohmeria macrophylla*	0.31	0.18	0.07	0.02	0.40
Katush	*Castonopsis tribuloides*	0.16	0.14	0.05	0.02	1.50
Khasre	*Ficus hirta*	0.31	0.12	0.07	0.02	2.69
Kutmiro	*Litsea polyanthea*	0.28	0.23	0.05	0.03	2.36
Lali	*Ampora wallichi*	0.29	0.15	0.07	0.03	1.39
Lute Khanyum	*Ficus elevate*	0.30	0.19	0.05	0.03	1.19
Melato	*Macranga nepalensis*	0.26	0.23	0.05	0.02	1.20
Pipli	*Exbucklandia populnea*	0.29	0.12	0.05	0.02	0.38
Rai Khanyum	*Ficus benjamina*	0.30	0.11	0.05	0.03	2.51
Rubber	*Ficus elastica*	0.29	0.48	0.06	0.03	1.32
Sial phurse	*Grevia elastica*	0.30	0.19	0.07	0.03	1.80
Sirish	*Albizia lebek*	0.29	0.17	0.06	0.03	1.36
Tanki	*Bauhinia purpurea*	0.30	0.15	0.05	0.05	1.80
Mean ± SE.		0.284±0.007	0.195±0.027	0.058±0.002	0.029±0.002	1.55±0.16

Each value for individual fodder is an average of 5 observations.

potassium in common forages. Adequacy of sodium in diet is more important than potassium not only due to its importance in sodium pump and its concentration being more in extracellular compartment but also due to its inadequate levels in various forages (Garg *et al.* 1999).

The result obtained for different trace elements in tree fodder revealed that copper concentration (mg/kg DM) varied from 12.8 in dudhilo (*Ficus nemoralis*) to 232.6 in gayo (Bridelia retusa). The zinc concentration (mg/kg DM) ranged from 19.70 in *dudhilo* (*Ficus nemoralis*) to 72.8 in *chiple* (*Reevesia pubescens*).The manganese concentration varied widely from sample to sample- the range being much wider. The lowest Manganese concentration (mg/kg DM) was once again in *kabra - Ficus infectoria* (31.0) closely followed by Rubber- *Ficus elastica* (32.2). The highest manganese concentration (758.0 mg/kg DM) was obtained in *jhingani* (*Eurya japonica*). The iron concentration (mg/kg DM) also varied widely from 39.8 in *lali* (*Ampora wallichi*) to 901.0 in *khasre* (*Ficus hirta*). The cobalt concentration varied narrowly from 0.01 to 1.30 mg/kg DM. The highest cobalt concentration was found in *khasre* (*Ficus hirta*) closely followed by melato (Macranga nepalensis).

The data revealed that all the tree leaves were rich in manganese and iron in comparison to other trace elements analyzed here. Das *et al.* (2003) also reported higher iron and manganese concentration in comparison to copper and zinc in tree fodders in hill zone of West Bengal. Gowda *et al.* (2001) reported higher Iron content in tree leaves in coastal zone of Karnataka. In the present study, cobalt concentration was the lowest in all the tree fodder. Garg *et al.* (2003) also reported lower cobalt content in feed stuffs. barhar, gayo, gineri, katush and sirish were richer sources of copper whereas, *barhar, chiple, gayo, luter khanyum* and *kabra* were richer source of zinc in comparison to other tree leaves. *Barhar, gayo, jhingani* and *katush* have much higher concentration of manganese. A considerable number of tree fodder analyzed here namely *khasre, luter khanyum, barhar, pipli, rai khanyum, sial phusre* and *tanki* are rich source of iron.

McDowell and Conrad (1977) reported the critical levels (mg/kg DM) of different trace elements in feed stuffs to be 8.0, 30.0, 40.0, 50.0 and 0.10, respectively, for Cu, Zn, Mn, Fe and Co. On that basis 42.86% of the total tree fodder samples analyzed here were deficient in Zn and 28.57% were deficient in Co. Only 9.52 and 4.76% samples were deficient in Mn and Fe, respectively. None of the samples was deficient in Cu. Out of 21, only 6 tree fodders namely *chiple, barhar, gayo, katush, khasre* and *rai khanyum* have all the trace elements in the concentration well above the critical levels.

The major factor affecting the mineral content of crop and forage plants are those involving genetics of the plants, soil where the plants are grown, climate and weather, stages of maturity and part of the plant. The above factors are interrelated. The knowledge about mineral content in different locally available feeds and fodder should help in identifying the deficiency of particular mineral elements in

Table 2. Micro element concentration in some tree fodder of Sikkim

Common name	Scientific name	Copper	Zinc	Manganese	Cobalt	Iron
Bat	*Ficus bengalensis*	21.0	20.3	98.3	0.50	284.1
Barhar	*Artocarpus lakoocha*	101.0	53.7	462.5	0.58	583.0
Chiple	*Reevesia pubescens*	32.4	72.8	155.7	0.40	364.8
Dudhilo	*Ficus nemoralis*	12.8	19.7	108.30	0.29	165.9
Gayo	*Bridelia retusa*	232.6	58.3	411.0	0.58	248.5
Gineri	*Premna mucronata*	101.5	46.7	249.6	0.02	257.8
Jhingani	*Eurya japonica*	20.3	24.2	758.0	0.60	381.9
Kabra	*Ficus infectoria*	35.4	55.5	31.0	0.41	323.9
Kamle	*Bohmeria macrophylla*	51.6	33.9	78.2	0.01	377.7
Katush	*Castonopsis tribuloides*	73.9	43.3	707.0	0.30	198.8
Khasre	*Ficus hirta*	41.6	43.5	47.6	1.30	901.0
Kutmiro	*Litsea polyanthea*	54.3	47.4	269.8	0.02	325.3
Lali	*Ampora wallichi*	33.2	34.4	285.0	0.43	39.8
Lute Khanyum	*Ficus elevate*	24.7	60.5	101.9	0.01	702.0
Melato	*Macranga nepalensis*	31.5	27.5	302.3	1.15	256.2
Pipli	*Exbucklandia populnea*	42.1	21.4	332.5	0.10	570.0
Rai Khanyum	*Ficus benjamina*	55.6	51.4	89.2	0.52	529.5
Rubber	*Ficus elastica*	18.6	26.2	32.2	0.39	343.6
Sial phurse	*Grevia elastica*	55.0	27.6	75.2	0.45	614.5
Sirish	*Albizia lebek*	71.1	28.8	113.7	0.03	209.0
Tanki	*Bauhinia purpurea*	41.6	25.2	76.6	0.01	628.0
Mean±SE		54.84± 10.38	39.16± 3.38	227.88±45.87	0.385± 0.08	368.34± 48.42

Each value for individual fodder is an average of 5 observations.

diet and accordingly possible nutritional intervention can be made with the aim to enhance the productivity and general health of the animals.

SUMMARY

The concentration of some important macro and micro elements were studied in 21 locally available tree fodder collected from different parts of Sikkim. The calcium and phosphorus concentration (% DM) ranged from 0.16 to 0.31 and 0.08 to 0.48, respectively. The magnesium concentration (% DM) was much lower ranging narrowly from 0.04 to 0.07. All the tree leaves were found to be richer in potassium in comparison to other macro elements analysed here the values ranging from 0.38 to 2.9% of DM. Sodium concentration (% DM) ranged from 0.02 to 0.06. The mean concentration (% DM) of different macro and micro elements in tree fodder analysed in the present investigation were 0.284 ± 0.007, 0.195 ± 0.027, 0.058 ± 0.002, 0.029 ± 0.002 and 1.55 ± 0.16, 54.85 ± 10.64, 39.16 ± 3.47, 227.9 ± 47.0, 0.39 ± 0.08, and 395.49 ± 46.75, respectively, for calcium, phosphorus, magnesium, sodium, potassium, copper, zinc, manganese, cobalt and iron. Out of 21, only 6 tree fodder namely, *chiple, barhar, gayo, katusha, khasre* and *rai khanyum*, have all the trace elements in the concentrations well above the critical levels. Forty two per cent of the total tree fodder samples analysed here were deficient in Zn and 28.5 per cent were deficient in Co. Only 9.5 and 4.7% samples were deficient in Mn and Fe, respectively. None of the samples were deficient in Cu.

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