Asian Journal of Chemistry; Vol. 29, No. 1 (2017), 65-68

ASIAN JOURNAL OF CHEMISTRY

http://dx.doi.org/10.14233/ajchem.2017.20133

Nutritional and Antinutritional Composition of Twenty Five Indigenous Leafy Vegetables of Jorhat District of Assam State, India

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Received: 11 June 2016; *Accepted*: 15 September 2016; *Published online*: 29 October 2016; AJC-18099

Twenty five indigenous plant materials were collected from various places of Jorhat district, India on the basis of popularity of use by the people of Jorhat district for evaluation of nutritional and antinutritional composition. The moisture content of the selected fresh leafy vegetables ranged from 76.40 to 92.47 %, ash content ranged from 7.80-14.70 %, crude fibre ranged from 2.50-26.10 %, crude fat ranged from 1.13-7.10 %, crude protein content ranged from 15.77 to 39.38 %, total free amino acid ranged from 79.37 to 992.00 mg %, soluble protein content ranged from 1.10 to 4.13 %, saponin content ranged from 0.23- 0.74 %, tannin content ranged from 0.37-2.82 %, phytic acid content ranged from 0.03-0.32 % and oxalate content ranged from 0.02-0.13 %. Indigenous leafy vegetables serve as a source of functional nutrients.

Keywords: Indigenous leafy vegetables, Wild, Edible plants, Tender, Dry powder, Plant materials.

INTRODUCTION

Wild leafy vegetables are ignored by people in the developed nations. These are subsistence agriculture in developing countries. Indigenous people in remote areas have deep knowledge about the use of these wild species as food during the period of drought, famine and civil unrest. The knowledge on these wild species could be considered as the most important determinant for an individual or a family to maintain nutritional requirement. Besides, wild vegetables have an important socio-economic impact on human through their uses in medicines, foods, fibers and cultural ceremonies [1]. In recent decades, interest has focused on wild plant species for their nutritional and medicinal values to broaden the diversity of human diet [2,3]. People today are more concern about the effects of modern agricultural technology and marketing and cultivate plant types that have high productivity, caused massive lost of biodiversity, reduction of genetic diversity of plants species. The high dietary selectivity has become important factor that cause difficulty in getting essential nutrients through daily diet caused malnutrition and under-nutrition [4]. Moreover, most of the foods consumed by people have been "upgraded" through refined and modified processes using various food preparation techniques such as cooking, crushing, leaching and husking that causes reduction or removal of certain essential nutrients from the food [5].

On the other hand, research on underutilized leafy vegetables in different regions showed that most of these wild greens have great nutritional values and antioxidant properties [3,6,7]. Glew *et al.* [6] reported that three usually consumed edible wild plants by the indigenous people in Niger (West Africa's Sahara region) have great influence on the nutritional status of local people due to their proportions of essential amino acids. Besides, Maisuthisakul *et al.* [7] found that indigenous chewing plants in Thailand contains great amount of phenolics and flavonoids, which responsible antiradical activities. Wild leafy vegetables, which regularly deprecate by policy makers and often considered 'weed of agriculture' are now not famine foods or wild foods in developing country, but serve as a source of functional nutrients.

Leafy vegetables (greens) play a major role in the Assamese diet, probably due to the influence of traditional herbal medicine, easy accessibility and low cost. Further, green leaves are considered as a main source of vitamins, minerals and fibre for local consumers. The use of wild plants as leafy vegetables is very common in Assam. Some of these species are also very popular but some species are sought-after more than others. In Assam they appear as uncultivated and semi cultivated crops or weedy and wild plants, with ecological, social and cultural values, playing a significant role in the daily food and nutritional requirement of local people mainly in the rural areas. However, there is no significant basis or reports in the modern literature regarding its nutritional and antinutritional composition. Thus, the present study was designed to evaluate the nutritional and antinutritional composition of the indigenous leafy vegetables of Jorhat district of Assam.

EXPERIMENTAL

Twenty five indigenous plant materials *viz., Bacopa monnieri* (L.) Wettst., *Leucas longifolia* Benth., *Enhydra fluctuans* DC., *Eryngium foetidum* L., *Amaranthus spinosus* L., *Pteridium aquilinum* (L.) Kuhn., *Amaranthus viridis* L., *Hydrocotyl rotundifolia* Lam., *Alternanthera sessilis* (L.) R.Br.ex DC., *Paederia foetida* L.; *Eclipta alba* L., *Houttuynia cordata* Thunb., *Talinum triangularae* (Jacq.) Wild, *Polygonum chinense* L., *Oxalis corniculata* L., *Oldenlandia corymbosa* (Wild.) Roxb., *Malva sylvestris* L., *Chrysopogon coroneriam* L., *Trigonella foenum-graecum* L., *Basella rubra* L., *Chenopodium album* L., *Stellaria media* (L.) Vill., *Basella alba* L., *Centalla asiatica* (L.) Urb. *and Oxalllis acetosella* L. were collected from various places of Jorhat district of Assam, India on the basis of popularity of use by the people of Jorhat district. These plants were planted in pot in the Department of Biochemistry and Agricultural Chemistry, Assam Agricultural University, Jorhat, India for investigation. Young tender edible parts of these plants species were collected and dried under sunshine and after dying milling were done in wily mill (IKON, Delhi). The dry powder was used for investigation

Moisture and ash content was determined by following the method of AOAC [8]. The crude fat content was determined by the method described by Thimmaiah [9]. The crude fibre content was determined by the method described by Sadasivam and Manickam [10]. The crude protein content was determined by Micro-Kjeldahl method described by AOAC [11]. The saponin content was determined by the method of Obadoni and Ochuko [12]. Phytic acid was extracted from each 1 g flour sample with 3 % trichloro-acetic acid by shaking at room temperature followed by high speed centrifugation as described by Wheeler and Ferrel [13]. The oxalate content was determined by the method given by NIN [14]. The tannin content was determined by the method given by Schanderl [15].

RESULTS AND DISCUSSION

The research findings of nutritional compositions are presented in Table-1 and antinutritional compositions are presented in Table-2.

Nutritional composition: The moisture content of the selected fresh leafy vegetables ranged from 76.40 to 92.47 g/100 g fresh weights (Table-1). The indigenous leafy vegetables *Talinum triangularae* contains highest moisture content (92.47 %) and *Oldenlandia corymbosa* contains lowest moisture content (76.40 %). Ng *et al.* [16] reported that the moisture content of the selected fresh wild vegetables ranged from 92.6 to 97.5 g/100 g fresh weights. The high moisture content of these plants give great impact on energy density (amount of energy in a given weight of food, kcal/g) as water adds substantial weight to the food without adding energy and this may give the consumers a better satiety without increase their energy intake. The ash content in this study was highest in *Basella alba* (14.70 %) and lowest in *Paederia foetida* (7.80 %) indicating

TABLE-1
NUTRITIONAL COMPOSITION ON DRY WEIGHT BASIS OF INDIGENOUS LEAFY VEGETABLES (g %)

S. No.	Local name	Botanical name	Moisture (FWB)	Ash	Crude fibre	Crude fat	Crude protein	Total free amino acid (mg %)	Soluble protein
1	Brahmi	*Bacopa monnieri*	83.59	8.70	9.13	3.10	24.67	167.34	1.85
2	Doron	*Leucas longifolia*	84.6	12.5	13.10	2.80	26.26	220.11	1.23
3	Helosi sak	*Enhydra fluctuans*	85.57	13.57	12.70	3.10	33.27	239.20	2.27
4	Mandhania	*Eryngium foetidum*	86.60	11.50	9.17	3.60	31.63	312.74	1.10
5	Hatikhotora	*Amaranthus spinosus*	86.45	13.50	5.80	3.13	36.76	383.47	2.40
6	Dhekia	*Pteridium aquilinum*	87.14	11.27	9.10	2.30	39.38	992.00	2.03
7	Khotora	*Amaranthus viridis*	89.95	14.60	7.20	2.80	30.65	868.21	2.76
8	Saru Manimoni	*Hydrocotyl rotundifolia*	89.55	12.87	15.10	2.13	24.54	970.72	1.90
9	Matikandori	*Alternanthera sessilis*	83.46	13.80	9.50	5.20	27.16	170.61	2.21
10	Bhedailata	*Paederia foetida*	79.63	7.80	20.40	2.10	16.64	79.37	1.47
11	Keheraj	*Eclipta alba*	91.09	13.80	16.10	2.13	23.64	168.08	1.86
12	Masundori	*Houttuynia cordata*	88.25	12.67	17.60	4.80	17.6	145.20	2.35
13	Pirali paleng	*Talinum triangularae*	92.47	13.20	9.10	4.70	29.77	234.98	4.13
14	Madhuholang	*Polygonum chinense*	91.14	9.77	12.20	3.20	34.15	250.65	3.51
15	Saru Tengesi	*Oxalis corniculata*	86.10	10.47	16.40	6.20	19.27	168.68	2.20
16	Bonjaluk	*Oldenlandia diffusa*	76.40	9.40	26.10	4.10	17.63	137.18	2.99
17	Laffa	*Malva sylvestris*	88.46	11.10	11.10	6.20	31.60	305.45	2.23
18	Baburi	*Chrysopogon coronerium*	91.27	8.70	6.20	2.70	31.60	329.06	2.69
19	Methi	*Trigonella foenum-graecum*	88.44	11.60	10.13	3.20	35.85	403.40	2.52
20	Puroi (red)	*Basella rubra*	92.19	13.70	5.50	7.10	18.40	173.78	2.92
21	Jilmil	*Chenopodium album*	86.63	14.60	4.40	3.90	36.76	365.52	2.78
22	Morolia	*Stellaria media*	85.39	13.30	4.67	2.30	20.47	200.27	2.43
23	Puroi (green)	*Basella alba*	92.77	14.70	2.50	4.20	28.10	223.35	2.62
24	Bor Manimoni	*Centalla asiatica*	83.54	12.70	8.90	1.13	15.77	129.27	2.40
25	Bor Tangeshi	*Oxalllis acetosella*	89.08	13.50	10.50	4.33	31.54	332.43	3.26
		SED (±)	0.41	0.09	0.10	0.09	1.89	0.25	0.12
		CD at 5 %	0.72*	0.15*	0.15*	0.20*	3.23*	0.42*	0.21*

TABLE-2
ANTINUTRITIONAL FACTORS (ON DRY WEIGHT BASIS) OF DIFFERENT INDIGENOUS LEAFY VEGETABLES (g %)

S. No.	Local name	Botanical name	Saponin	Tannin	Phytic acid	Oxalate
1	Brahmi	*Bacopa monnieri*	0.54	1.63	0.23	0.08
2	Doron	*Leucas longifolia*	0.29	1.91	0.32	0.11
3	Helosi sak	*Enhydra fluctuans*	0.41	0.66	0.27	0.07
4	Mandhania	*Erynginum foetidum*	0.23	1.45	0.18	0.06
5	Hatikhotora	*Amaranthus spinosus*	0.50	0.76	0.17	0.09
6	Dhekia	*Pteridium aquilinum*	0.32	2.38	0.15	0.03
7	Khotora	*Amaranthus viridis*	0.29	1.10	0.10	0.04
8	Saru Manimoni	*Hydrocotyl rotundifolia*	0.40	0.70	0.2	0.04
9	Matikandori	*Alternanthera sessilis*	0.38	0.57	0.10	0.03
10	Bhedailata	*Paederia foetida*	0.31	2.82	0.07	0.04
11	Keheraj	*Eclipta alba*	0.34	2.14	0.27	0.07
12	Masundori	*Houttuynia cordata*	0.56	1.36	0.26	0.08
13	Pirali paleng	*Talinum triangularae*	0.74	1.35	0.08	0.02
14	Madhuholang	*Polygonum chinense*	0.33	1.33	0.06	0.03
15	Saru Tengesi	*Oxalis corniculata*	0.43	0.82	0.08	0.04
16	Bonjaluk	*Oldenlandia diffusa*	0.40	1.85	0.19	0.02
17	Laffa	*Malva sylvestris*	0.30	2.43	0.22	0.13
18	Baburi	*Chrysopogon coronerium*	0.33	1.39	0.15	0.05
19	Methi	*Trigonella foenum-graecum*	0.61	1.92	0.13	0.09
20	Puroi (red)	*Basella rubra*	0.50	2.7	0.21	0.12
21	Jilmil	*Chenopodium album*	0.41	1.15	0.06	0.02
22	Morolia	*Stellaria media*	0.38	0.37	0.03	0.03
23	Puroi (green)	*Basella alba*	0.47	0.89	0.22	0.13
24	Bor Manimoni	*Centalla asiatica*	0.26	1.16	0.21	0.03
25	Bor Tangeshi	*Oxalllis acetosella*	0.61	1.12	0.09	0.07
		SED (±)	0.01	0.08	0.01	0.008
		CD at 5 %	0.02*	0.14*	0.14*	0.01*

that consumption of these wild greens might contribute higher minerals content. Ng *et al.* [16] reported that the ash content of wild vegetables ranged from 13-18 g/100 g on dry weight basis. The indigenous leafy vegetables used in this study showed crude fibre content which is ranged from 2.50-26.10 %.

The highest crude fibre content was found in *Oldenlandia corymbosa* (26.10 %) and lowest in *Basella alba* (2.50 %). The other leafy vegetables *Paederia foetida*, *Houttuynia cordata, Oxalis corniculata and Leucas longifolia* are also provide 20.40, 17.60, 16.40 and 13.10 % of crude fibre respectively on dry weight basis. Similar results were obtained by Flyman *et al.* [2] and Ng *et al.* [16]. The crude fat content of these leafy vegetables of present investigation was ranged from 1.13-7.10 % on dry weight basis. The crude fat content was highest in *Basella rubra* (7.10 %) and lowest in *Centalla asiatica* (1.13 %). The percentage of fat content ranged from 3.51-14.02 % on dry weight basis in Bushbuck and *Amaranthus hybridus* obtained by Asaolu *et al*. [17]. Hence, these wild greens could potentially be a source of high fibre and low fat diet for those who concern about their weight or on weight management program.

The crude protein content of these leafy vegetables ranged from 15.77 to 39.38 % on dry weight basis. The crude protein content in this study was highest in *Pteridium aquilinum* (39.38 %) and lowest in *Centalla asiatica* (15.77 %). Kamga *et al.* [18] reported that crude protein content in wild leafy vegetables ranged from 9.4 to 38.18 %. These leafy vegetables can play a significant role in providing cheap and affordable protein for rural communities. Levels of crude protein found in the three leafy vegetables in one study are within the range of 20.48-41.66 % reported Ponka *et al.* [19].

The total free amino acid of these leafy vegetables ranged from 79.37 to 992.00 mg % on dry weight basis. The total free amino acid content in this study was highest in *Pteridium aquilinum* (992.00 mg % and lowest in Bhedailata (79.37 mg %). There is a significant difference among the plant species. The results are lower as compared to the results obtained by Laitonjam *et al.* [20] in the leaves of *Phlogacanthus pubinervius* and *Phlogacanthus jenkinsii* were 5312.50 and 4140.75 mg/ 100 g, respectively. The soluble protein content of these leafy vegetables ranged from 1.10 to 4.13 % on dry weight basis. The data of the present investigation revealed that Pirali paleng (4.13 %) has the highest soluble protein content and Mandhania (1.10 %) has the lowest soluble protein content. There is a significant difference among the plant species. The results are comparable to the results obtained by Lin and Ho [21] in the leaf of four cultivars of sweet potato Tainong 65, HP-4, Chang-hua and Tainong 25 contains total soluble protein 6.79 g/100 g, 5.8 g/100 g, 5.02 g/100 g and 4.25 g/100 g, respectively and Alfawaz [22] found that the soluble protein value of hummayd was 17.1-20.1 g/100 g.

Antinutritional composition: Most saponins – "soap forming compound" – occur as glycosides. They are structurally distinct, but have main functional properties in common. Saponins show immune modulating and antineoplastic effects. Some saponins induce photosensitization and jaundice. The saponin level of indigenous leafy vegetables of the present study ranged from 0.23-0.74 %. The saponin content was highest in *Talinum triangularae* (0.74 %) and lowest in *Erynginum foetidum* (0.23 %). Similar results were also obtained by several authors [23-25]. Sood *et al*. [26] reported that saponin content in different cultivars of *Chenopodium* ranged from 0.027 to 0.867 %. A tannin content ranged of 0.37-2.82 % was determined in the twenty five samples used in the study. The highest tannin content among the studied plant was seen in *Paederia foetida* (2.82 %) and lowest in *Stellaria media* (0.37 %). The concentration of tannin is comparatively lower than those that other workers have reported [25,27]. The interest in dietary tannin was due to evidence of adverse effects. For instance, tannins in the diet are reported to cause growth depression [28] and have the potential to complex divalent ions (Zn, Fe, Cu, *etc.*) resulting in their unavailability. The unavailability of Zn causes paralysis [24].

The phytic acid content in indigenous leafy vegetables of the present study was ranged from 0.03-0.32 %. The highest phytate content among the studied plant was seen in *Leucas longifolia* (0.32 %) and lowest in *Stellaria media* (0.03 %). However, this was similar with the report of Wallace *et al.* [23]. High dietary phytate content is reported to cause growth reduction [29], affect food value by binding and making mineral ions unavailable to the consumer, affect homeostasis of Zn and Fe, inhibit enzymatic digestion of proteins and cause rickets in young dogs [30]. The low level of phytate in the leaves would be nutritionally advantageous.

The oxalate content in indigenous leafy vegetables of the present study was ranged from 0.02-0.13 % which is far lower than that determined in six leafy vegetables by Gupta *et al.* [25]. The highest oxalate content among the studied plant was seen in *Malva sylvestris, Basella alba* (0.13 %) and lowest in *Talinum triangularae, Chenopodium album* (0.02 %). The same sources also contained similar information on the effect of oxalate compounds in chelating bivalent minerals such as calcium and iron. This has serious negative effect on health, particularly vulnerable groups *viz.* children, pregnant and lactating mothers that require more calcium and iron.

Conclusion

Indigenous leafy vegetables considered as 'weed of agriculture' and depicted as famine foods or wild foods in developing country. But now the situation has been changed and it becomes the source of functional nutrients.

ACKNOWLEDGEMENTS

The authors express their gratitude to Department of Biochemistry and Agricultural Chemistry, Assam Agricultural University, Jorhat, India for all the facilities to carry out this research work.

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