Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2013, 5(3):117-121

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Mineral content of some wild green leafy vegetables of North-East India

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ABSTRACT

In the present study, macroelements (Na, K, Ca, Mg and P) and trace elements (Fe, Zn, Cu Mn, Cr and Ni) content of fresh and cooked vegetables of twenty one wild vegetables traditionally consumed in North-East India were examined. All the examined vegetables are found to be rich source of macroelements as well as trace minerals. Calcium is the most abundant macroelement ranging from 125.7 mg/100g to 543.2 mg/100g. Cooking significantly ($p<0.05$) decreases the level of potassium, magnesium, phosphorous and calcium in most of vegetables. Iron is the most abundant microelement in the examined vegetables which ranged between 6.97 mg/100g to 22.73 mg/100g. Cooking has no significant ($p>0.05$) effect on the trace elements of most of vegetables.

Keywords: Green Leafy Vegetables, Macroelements, Trace elements, Micronutrient deficiency, North-East India.

INTRODUCTION

Micronutrient malnutrition is of major and serious concern for many tropical developing countries [1, 2]. Micronutrient deficiency affects over two billion people worldwide, resulting in poor health, low worker productivity, high rate of mortality and morbidity [3]. Iron deficiency anemia, for example, is one of the important worldwide health problems affecting nearly thirty percent of the world's population [4]. As vegetables are the excellent sources of vitamin C, beta–carotene, and mineral constituents whose importance in human health is undisputable [5]. Adequate intake of essential mineral is necessary for remain healthy as they are involved in numerous biochemical processes [1, 6].

Vegetables constitute a major part of daily food intakes by human population all over the world. Vegetables play an important role in well- balanced diet [7]. In a well-balanced died it is advised to intake more vegetables and fruits but lesser amount of red meat [8]. Diets reach in vegetables and fruits are link to reduce the risk of diseases like diabetes, cancer, coronary heart disease, neurodegenerative ailment [9, 10]. A low intake of fruits and vegetables does not only the put the people at the risk for micronutrient deficiencies but it is also among top ten risk factors contributing mortality worldwide [11]. About thirty elements are recognized as being indispensable to some form of life. Some of them such as Na, K, Mg, Ca or Fe are indispensables in the sustainment of human health while other such as Cu or Zn are equally indispensable but in this case the interval between the expectable and toxic levels is limited [12]. Due to their high water content leafy vegetables are believed to occupy a modest place as a source of trace elements [13]. Essential minerals can be divided into two groups, major minerals (Na, K, Mg, Ca, P, S) which are required in amounts greater than100 mg per day and they represents 1% or less of body weight while the other are considered as trace minerals (Fe, Zn, Cu, I, Si, Mn, F, I, Cr) which are required in an amount less than 100 mg per day and they represent less than 0.01 % of body weight [14].

Looking into the occurrence of high level of micronutrient malnutrition among the vulnerable section in the developing counties and increasing prevalence of chronic degenerative diseases worldwide, the need of exploration of underutilized food is significant to overcome the nutritional disorder [15]. As the green leafy vegetables (GLV) are excellent sources of micronutrients, consumption of green leafy vegetables may play an important role to overcome the micronutrient deficiencies as well as to prevent the degenerative diseases [16, 17]. North-east region of India is rich in plant biodiversity along with human race diversity with distinct culture and food habits. The people of this region are traditionally using different types of wild plants as food from a long time. However there is a very little information on the mineral composition of these wild vegetables. This study was therefore undertaken to assess the mineral composition of 21 wild leafy vegetables consumed in North-east India.

EXPERIMENTAL SECTION

Materials

21 wild species of leafy vegetables (**Table 1**) were collected from Bongaigaon, Darrang and Kamrup district of Assam, North East India, and were identified by a taxonomist. Fresh vegetables were cleaned and external moistures were blotted dry with tissue paper and non-edible portions separated and discarded. Edible portions were cut into small pieces and subjected to analysis.

Raw sample

Weighted quantity of fresh vegetable was dried at temperature below 65 °C. The dried samples were considered as raw samples.

Cooked sample

Raw sample, cut into small pieces, was taken in a stainless vessel and boiled in tap water. Vegetables were cooked until they became suitable for consumption. Quantity of water used was just sufficient to cook the vegetable practically leaving no residual water. The cooked vegetables were dried in oven at 60±5 °C for constant weight and used for estimation of minerals. Pressure cooking was not employed because all these vegetables are usually cooked under atmospheric pressure.

Analyzed

For analysis of Ca, P, Na, K, Mg, Cr, Zn weighted quantity of each dried sample was subjected to preparation of ash by incineration in a muffle furnace at 550 °C [24]. 1 g of the calcined ash of each sample was digested with triple acid mixture (1: 2: 4) HCl-HNO_3-H_2SO_4 to dryness. The residue was dissolved in 2N HNO_3, the insoluble portion was filtered out with Whatman 42 filter paper; the filtrate was made up to 50 ml and was preserved for analysis of the metals. The concentration of Cr, Mg, Ca and Zn was measured by Atomic Absorption Spectrophotometer (Perkin Elmer AAnalyst 200). Na and K were analyzed by flame photometry. P was analyzed by colorimetric method using molybdovanadate reagent.

For the analysis of Fe, Mn, Cu, Ni, and Co, 0.5 g of dried samples was digested with 5 ml of HCl-HNO_3 (1:3) for 1 h, and getting semi dried again 5 ml of HCl- HNO_3 was added and further digested for 1 h. The semi dried material was dissolved in 50 ml 2N HNO_3 and filtered with Whatman 42 filter paper. Minerals were examined by Atomic Absorption Spectrophotometer (Perkin Elmer AAnalyst 200).

Table 1. List of some wild green leafy vegetables

Scientific name	Family	Local name	Edible part used
Lasia spinosa (L)Thw	Araceae	Seng mora	Whole plant
Polygonum microcephalum D. Don	Polygonaceae	Madhu saleng	Twigs
Colocasia esculenta (L) Schott	Araceae	Kola kasu	Leaf
Amorphophallus paconiifolius (Dennst) Nicolson	Araceae	Ol kasu	Whole plant
Talinum triangulare (Jacq.) Willd.	Portulacaceae	Bilati paleng	Leaf
Ipomea aqatica Forrsk	Convolvolaceae	Kolmou	Twigs
Alternanthera sesilis (L.) R. Br. ex DC.	Amaranthaceae	Mati kaduri	Twigs
Pygmaeopremana herbacca Roxb.	Verbenaceae	Mati vasua	Twigs
Centella asiatica (L.) Urban	Apiaceae	Bor manimoni	Whole plant
Hydrocotyle sibthopioides Lamk	Apiaceae	Saru maninoni	Whole plant
Murrya koenzii (L) Spreng	Rutaceae	Narasingha	Twigs
Paederia scandens (Lour) Merr.	Rubiaceae	Vadai lata	Leaf
Achasma nigra (Gaertn) Buru	Zingiberaceae	Tora	Steam
Ardisia colorata Roxb.	Myrsinaceae	Nol tenga	Leaf
Enhydra fluctuans Lour.	Asteraceae	Helachi	Twigs
Amaranthus viridis	Amaranthaceae	Khutura	Twigs
Celosia argentea	Amaranthaceae	Bhulki	Twigs
Derringia amaranthoides (Lamk) Merr	Amaranthaceae	Methok thoka	Twigs
Houttuynia cordata Thunb	Saururaceae	Masandari	Leaf
Oxalis corniculata L	Oxalidaceae	Saru Tengasi	Whole plant
Oxalis debilis var. *corymbosa*(DC) Lour	Oxalidaceae	Bar Tengasi	Whole plant

RESULTS AND DISCUSSION

The results of the analysis for macro-mineral content of the green leafy vegetables are presented in the **Table 2**. The sodium concentration of the raw vegetables ranged between 2.7 mg/100g (*Amorphophallus paconiifolius*) to 30.7 mg/100g (*Hydrocotyle sibthopioides*). Cooking decreases the sodium content of the vegetables which was not significant ($p>0.05$) in most of the cases. Significant decrease ($p<0.05$) of sodium content after cooking was observed in *Centella asiatica*, *Hydrocotyle sibthopioides*, *Murrya koenzii*, *Derringia amaranthoides* and oxalis debilis var. corymbosa. The potassium content of the raw and cooked vegetables was found to be higher than that of the sodium content. In the raw samples potassium content ranged between 108.7 mg/100g (*Colocasia esculenta*) to 490.4 mg/100g (*Ipomea aqatica*). Cooking significantly ($p<0.05$) decreases the potassium concentration. Consumption of too much Na and less amount of K contributes high prevalence of hypertension [25]. The Na/K ratio in our body is of great concern to prevent high blood pressure and the ratio should be less than one [26]. All these vegetables are found to have Na/K ratio less than one, and therefore consumption of these vegetables may control the high blood pressure. Calcium and phosphorous are important for growth and healthy maintenance of bones, teeth, muscles and blood can be made [26, 27].

Table 2. Macro-mineral content of the raw and cooked green leafy vegetables (mg/100g of edible portion)

Sample	Raw/ cooked	Na	K	Ca	Mg	P
Lasia spinosa	raw	6.9 ± 0.4	170.4 ± 10.1	543.2 ± 31.4	85.7 ± 3.4	43.8 ± 2.6
	cooked	6.1 ±0.7	157.1± 10.7	576.4 ± 32.1	74.5 ± 3.7	28.4 ± 2.2
Polygonum microcephalum	raw	8.4 ± 0.6	146.9 ± 10.2	243.3 ± 21.3	116.3 ± 4.1	58.3 ± 5.7
	cooked	7.1 ± 0.5	132.7 ± 9.1	232.1 ± 20.1	87.8 ± 3.7	43.7 ± 4.2
Colocasia esculenta	raw	4.1 ± 0.7	108.8 ± 12.5	476.7 ± 31.1	87.3 ± 5.2	42.8 ± 3.1
	cooked	4.3 ± 0.7	101.1 ± 7.6	492.1 ± 30.7	81.2 ± 4.2	28.2 ± 2.3
Amorphophallus paconiifolius	raw	2.7 ± 0.2	114.3 ± 12.3	483.6 ± 27.9	112.9 ± 8.5	58.7 ± 3.1
	cooked	2.6 ± 0.3	87.8 ± 5.3	497.2 ± 31.1	76.5 ± 6.3	43.4 ± 4.2
Talinum triangulare	raw	8.5 ± 1.1	138.8 ± 7.7	321.5 ± 14.4	201.2 ± 10.5	43.2 ± 3.2
	cooked	7.1 ± 0.6	134.5 ± 12.1	311.1 ± 22.1	165.4 ± 7.3	32.1 ± 2.1
Ipomea aqatica	raw	5.2 ± 0.7	490.4 ± 37.8	243.7 ± 24.4	118.2 ± 8.2	37.7 ± 2.1
	cooked	5.0 ± 0.3	367.2 ± 31.1	209.2 ± 21.5	114.7 ± 5.8	23.2 ± 2.4
Alternanthera sesilis	raw	9.9 ± 0.4	210.4 ± 25.3	276.6 ± 12.3	57.4 ± 5.2	57.7 ± 6.4
	cooked	8.1 ± 1.1	170.1 ± 21.2	242.1 ± 21.1	51.2 ± 5.1	43.2 ± 3.1
Pygmaeopremana herbacca	raw	10.1± 0.8	139.3 ± 16.9	158.7 ± 16.3	87.8 ± 7.7	54.8 ±6.7
	cooked	8.7 ± 1.2	128.1 ± 11.3	137.1 ± 17.1	93.2 ± 5.1	43.1 ± 3.1
Centella asiatica	raw	27.7 ± 1.8	361.1 ± 23.2	147.5 ± 14.6	116.9 ± 5.6	43.7 ± 3.1
	cooked	21.8 ± 1.3	287.2 ± 21.2	118.1 ±12.1	87.7 ± 4.3	26.1 ± 1.7
Hydrocotyle sibthopioides	raw	30.7 ± 2.2	393.6 ± 33.1	151.4± 12.2	111.6 ± 5.7	48.9 ± 2.7
	cooked	24.5 ± 1.7	301.5 ± 26.1	127.1 ± 16.7	87.5 ± 4.7	32.7 ± 2.1
Murrya koenzii	raw	16.3 ± 1.4	260.3 ± 18.6	136.2 ± 12.3	142.4 ± 8.7	46.8 ± 3.8
	cooked	12.3 ± 1.2	254.3 ± 13.1	121.1 ± 12.3	143.3 ± 10.7	32.1 ± 2.1
Paederia scandens	raw	8.8 ± 0.5	374.7 ± 31.9	125.7 ± 14.7	183.6 ± 10.8	32.7 ± 3.1
	cooked	7.3 ± 0.9	323.2 ± 23.1	117.1 ± 12.1	124.7 ± 7.6	21.1 ± 2.1
Achasma nigra	raw	3.8 ± 0.2	131.1 ± 16.4	287.7 ± 17.3	34.4 ± 4.7	27.7 ± 3.2
	cooked	3.2 ± 0.2	130.2 ± 12.1	297.3 ± 21.1	30.3 ± 2.3	23.1 ± 1.1
Ardisia colorata	raw	3.0 ± 0.2	144.2 ± 12.4	223.8 ± 21.6	117.7 ± 8.9	26.7 ± 2.1
	cooked	3.3 ± 0.5	123.8 ± 10.2	197.1 ± 14.1	97.3 ± 4.3	18.1 ± 1.2
Enhydra fluctuans	raw	9.4 ± 0.4	317.1 ± 15.9	247.2 ± 23.1	134.3 ± 8.8	33.8 ± 2.1
	cooked	9.2 ± 0.7	267.2 ± 17.1	187.7 ± 26.8	98.4 ± 5.3	23.1 ± 1.7
Amaranthus viridis	raw	19.7 ± 0.7	364.5 ± 23.1	273.2 ± 23.1	123.6 ± 10.2	46. 2 ± 1.3
	cooked	18.1 ± 1.1	312.2 ± 21.1	257.8 ± 21.9	87.4 ± 6.3	36.2 ± 2.1
Celosia argentea	raw	14.6 ± 0.7	208.1 ± 17.2	241.2 ± 21.2	144.3 ± 12.1	42.2 ± 2.6
	cooked	12.1 ± 1.2	176.1 ± 12.1	212.6 ± 20.7	132.6 ± 7.1	27.1 ± 2.1
Derringia amaranthoides	raw	16.5 ± 1.4	317.8 ± 27.2	251.7 ± 24.3	143.3 ± 11.3	52.7 ± 4.2
	cooked	12.3 ± 1.8	301.1 ± 21.1	243.7 ± 21.7	112.7 ± 10.4	37.2 ± 3.1
Houttuynia cordata	raw	17.9 ± 0.9	348.6 ± 21.2	187.4 ± 16.2	114.3 ± 12.1	41.1 ± 2.7
	cooked	17.1 ± 1.1	301.2 ± 18.9	157.2 ± 17.1	84.3 ± 7.2	30.7 ± 2.6
Oxalis corniculata	raw	22.5 ± 2.4	263.3 ± 20.7	132.2 ± 12.2	87.3± 10.2	35.1 ± 2.1
	cooked	20.7 ± 1.3	236.1 ± 12.7	124.1 ± 15.1	81.1 ± 10.1	27.2 ± 2,5
Oxalis debilis var. *corymbosa*	raw	21.7 ± 1.2	247.4 ± 19.5	129.4 ± 12.4	91.2 ± 7.3	32.8 ± 1.6
	cooked	18.1 ± 1.7	132.1 ± 16.1	112.6 ± 14.2	87.1 ± 8.2	21.2 ± 1.7

All data are the means ±SD of triplicate experiment (n=3)

Ca is the most abundant macro-minerals of the studied vegetables, ranged from 125.7 mg/100g (*Paederia scandens*) to 543.2 mg/100g (*Lasia spinosa*). Most of cases cooking significantly ($p<0.05$) decreases the calcium level, however, in some cases cooking increases the calcium level. The value for magnesium in these vegetables ranged from 34.4 mg/100g (*Achasma nigra*) to 201.2 mg/100g (*Talinum triangulare*). Mg involved in bone mineralization, protein synthesis, enzyme action, normal muscular contraction, nerve transmission. Dietary deficiency of magnesium which is linked with ischemic heart disease [28] could be prevented by the regular consumption of these vegetables as all these vegetables are good source of magnesium. Cooking significantly ($p<0.05$) decreases the magnesium level in most of vegetables, the results are agreed with reported by [29] for some South African leafy vegetables. The levels of phosphorous in the vegetables ranged between 26.7 mg/100g (*Ardisia colorata*) to 58.3 mg/100g (*Polygonum microcephalum*). Cooking decreases the level of phosphorous.

Table 3. Micro-mineral content of the raw and cooked green leafy vegetables (mg/100g of edible portion)

Sample	Raw/ cooked	Fe	Zn	Cu	Mn	Cr	Ni
Lasia spinosa	raw	12.16 ± 0.43	0.82 ± 0.10	0.12 ± 0.03	0.23 ± 0.01	0.171± 0.011	0.141± 0.005
	cooked	12.71 ± 0.57	0.80 ± 0.11	0.17 ± 0.03	0.24 ± 0.03	0.076 ± 0.010	0.143 ± 0.012
Polygonum microcephalum	raw	12.12 ± 0.21	0.46 ± 0.04	0.09 ± 0.01	0.78 ± 0.17	0.054 ± 0.010	0.012 ± 0.000
	cooked	12.70 ± 0.78	0.47 ± 0.03	0.12 ± 0.02	0.71 ± 0. 11	0.051 ± 0.021	0.015 ± 0.001
Colocasia esculenta	raw	16.97 ± 1.54	0.83 ± 0.07	0.21 ± 0.03	0.33 ± 0.03	0.062 ± 0.012	0.076 ± 0.012
	cooked	16.76 ± 1.12	0.84 ± 0.09	0.23 ± 0.04	0.29 ± 0.03	0.065 ± 0.021	0.078 ± 0.015
Amorphophallus paconiifolius	Raw	12.19 ± 0.91	0.93 ± 0.11	0.12 ± 0.01	0.38 ± 0.01	0.123 ± 0.021	0.021 ± 0.005
	cooked	12.71 ± 0.98	0.91 ± 0.08	0.22 ± 0.04	0.35 ± 0.03	0.120 ± 0.031	0.027 ± 0.004
Talinum triangulare	raw	8.46 ± 0.44	0.25 ± 0.02	0.16 ± 0.01	0.87 ± 0.22	0.054 ± 0.012	nd
	Cooked	9.78 ± 0.51	0.31 ± 0.04	0.12 ± 0.02	0.84 ± 0.21	0.057 ± 0.021	nd
Ipomea aqatica	Raw	10.94 ± 1.12	0.29 ± 0.03	0.15 ± 0.01	0.42 ± 0.07	0.081 ± 0.031	0.054 ± 0.005
	Cooked	9.78 ± 0.89	0.27 ± 0.02	0.16 ± 0.03	0.41± 0.05	0.083 ± 0.021	0.051 ± 0.012
Alternanthera sesilis	Raw	22.73 ± 1.21	1.10 ± 0.17	0.27 ± 0.04	1.21 ± 0.23	0.078 ± 0.023	0.076 ± 0.017
	Cooked	21.78 ± 2.10	0.97 ± 0.08	0.18 ± 0.02	1.17 ± 0.18	0.075 ± 0.012	0.078 ± 0.012
Pygmaeopremana herbacca	Raw	14.87 ± 1.50	0.76 ± 0.07	0.17 ± 0.00	1.31 ± 0.21	0.112 ± 0.037	0.067 ± 0.014
	Cooked	14.11 ± 1.23	0.78 ± 0.07	0.12 ± 0. 04	1.24 ± 0..21	0.123 ± 0.021	0.071 ± 0.014
Centella asiatica	Raw	11.16 ± 1.43	0.91 ± 0.10	0.78 ± 0.11	1.43 ± 0.24	0.097 ± 0.027	0.087 ± 0.007
	Cooked	12.35 ± 1.56	0.90 ± 0.07	0.65 ± 0.06	1.21 ± 0.12	0.091 ± 0.012	0.085 ± 0.021
Hydrocotyle sibthopioides	Raw	12.76 ± 1.76	1.21 ± 0.11	0.92 ± 0.12	1.77 ± 0.27	0.021 ± 0.001	0.043 ± 0.006
	Cooked	12.77 ± 0.75	1.10 ± 0.10	0.85 ± 0.07	1.71 ± 0.15	0.023 ± 0.004	0.045 ± 0.011
Murrya koenzii	Raw	9.87 ± 0.65	0.46 ± 0.07	0.36 ± 0.05	1.70 ± 0.19	0.042 ± 0.011	0.043 ± 0.008
	Cooked	9.15 ± 0.78	0.46 ± 0.04	0.46 ± 0.06	1.67 ± 0.21	0.045 ± 0.012	0.045 ± 0.011
Paederia scandens	Raw	18.39 ± 2.10	0.48 ± 0.08	0.76 ± 0.07	0.86 ± 0.13	0.072 ± 0.021	0.078 ± 0.017
	Cooked	14.78 ± 1.78	0.43 ± 0.01	0.83 ± 0.07	0.87 ± 0.12	0.076 ± 0.012	0.075 ± 0.012
Achasma nigra	Raw	6.97 ± 0.43	0.59 ± 0.14	0.21 ± 0.02	0.41 ± 0.03	0.043 ± 0.011	0.021 ± 0.008
	Cooked	6.76 ± 0.57	0.61 ± 0.04	0.23 ± 0.03	0.47 ± 0.05	0.045 ± 0.013	0.025 ± 0.007
Ardisia colorata	Raw	16.64 ± 2.12	0.78 ± 0.17	0.59 ± 0.12	0.16 ± 0.02	0.011 ± 0.001	0.076 ± 0.019
	Cooked	16.27 ± 1.76	0.75 ± 0.06	0.58 ± 0.08	0.21 ± 0.02	0.021 ± 0.000	0.075 ± 0.013
Enhydra fluctuans	Raw	15.72 ± 1.78	0.46 ± 0.05	0.08 ± 0.01	0.25 ± 0.02	0.451 ± 0.110	0.054 ± 0.004
	Cooked	12.78 ± 1.78	0.45 ± 0.04	0.12 ± 0.02	0.28 ± 0.04	0.437 ± 0.101	0.051 ± 0.011
Amaranthus viridis	Raw	18.72 ± 2.76	0.83 ± 0.12	0.31 ± 0.10	0.63 ± 0.10	0.022 ± 0.005	0.021 ± 0.002
	Cooked	20.78 ± 2.11	0.81 ± 0.07	0.35 ± 0.04	0.67 ± 0.07	0.032 ± 0.007	0.025 ± 0.007
Celosia argentea	Raw	14.12 ± 1.34	0.64 ± 0.18	0.27 ± 0.07	0.54 ± 0.10	0.045 ± 0.012	nd
	Cooked	8.78 ± 0.78	0.61 ± 0.07	0.21 ± 0.02	0.48 ± 0.07	0.051 ± 0.007	nd
Derringia amaranthoides	Raw	16.78 ± 2.79	0.63 ± 0.13	0.37 ± 0.05	0.57 ± 0.09	0.075 ± 0.011	nd
	Cooked	16.14 ± 1.78	0.62 ± 0.09	0.43 ± 0.05	0.58 ± 0.10	0.076 ± 0.013	nd
Houttuynia cordata	Raw	14.07 ± 1.87	0.76 ± 0.08	0.51 ± 0.12	0.79 ± 0.27	0.107 ± 0.031	0.067 ± 0.005
	Cooked	12.90 ± 2.12	0.76 ± 0.05	0.37 ± 0.07	0.87 ± 0.11	0.112 ± 0.043	0.065 ± 0.014
Oxalis corniculata	Raw	11.67 ± 0.87	0.57 ± 0.12	0.41 ± 0.02	0.43 ± 0.07	0.076 ± 0.022	0.034 ± 0.005
	Cooked	11.56 ± 1.51	0.58 ± 0.07	0.42 ± 0.02	0.37 ± 0.05	0.078 ± 0.021	0.037 ± 0.011
Oxalis debilis var. *corymbosa*	Raw	11.10 ± 1.13	0.58 ± 0.14	0.35 ± 0.01	0.47 ± 0.07	0.063 ± 0.012	0.023 ± 0.005
	Cooked	12.20 ± 1.57	0.51 ± 0.07	0.32 ± 0.03	0.42 ± 0.04	0.067 ± 0.012	0.027 ± 0.011

All data are the means ±SD of triplicate experiment (n=3)

The analysis results for micro-mineral contents of green leafy vegetables are shown in **Table 3**. Values for iron in these vegetables ranged from 6.97 mg/100g (*Achasma nigra)* to 22.73 mg/100g (*Alternanthera sesilis*) which compares favorably to most values reported for green leafy vegetables in literatures [4, 15]. Inadequate dietary intake and poor bioavailability of iron from food are the major etiological factors of anemia [4]. Regular consumption of these vegetables can prevent the iron deficiency anemia. Cooking has no significant effect on the level of iron of these vegetables. The level of zinc of these vegetables ranged between 0.25mg/100g (*Talinum triangulare*) to 1.21 mg/100g (*Hydrocotyle sibthopioides*). The level of zinc studied in these vegetables compares favourably with the value reported in some green leafy vegetables [15, 29, 30]. Zinc is essential for the functioning of over 300 enzymes and takes part in enormous numbers of biological process [8]. Zinc deficiency is associated with impaired gastrointestinal and immune function [11]. Cooking has no effect on zinc content. Copper level of the vegetables ranged from 0.08 mg/100g (*Enhydra fluctuans*) to 0.92 mg/100g (*Hydrocotyle sibthopioides*). Cooking has no such significant effect, however in some cases both increase and decrease in the copper level was observed. Copper and manganese are essential for human because they exhibit a wide range of biological functions such as component of enzymatic and redox system [31]. Values for manganese for these vegetables ranged from 0.16 mg/100g (*Ardisia colorata*) to 1.77 mg/100g (*Hydrocotyle sibthopioides*). Manganese plays an important role in the metabolism of protein, carbohydrate, lipid and in the production of steroid sexual hormones [32]. Cooking has no significant effect on manganese concentration. The level of chromium in these vegetables ranged between 0.011 mg/100g (*Ardisia colorata*) to 0.451 mg/100g (*Enhydra fluctuans*). Chromium is important for hormone and enzyme activity [33]. Cooking has no effect on chromium level. Nickel is important trace element which plays its role as coenzyme in different enzyme such as urease [34]. *Lasia spinosa* (0.141 mg/100g) contain the highest nickel concentration. Cooking has no effect on the nickel content.

CONCLUSION

The study of wild GLV revealed that they are good sources for macro- and micro-minerals. Majority of the GLV are rich source of calcium, potassium, magnesium, phosphorous, iron and zinc. So it can be concluded that regular consumption of these GLV can meet the nutritional requirement to overcome the micronutrient malnutrition at minimum cost.

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