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Chemical composition of some medicinal plant products of indigenous origin

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Abstract

Chemical compositions of leaves of neem (*Azadirachta indica*), sajna (*Moringa oleifera*), arjun (*Terminalia arjuna*), tulsi (*Ocimum sanctum*), turmeric (*Curcuma longa*); rhizomes of ginger (*Zingiber officinale*) and turmeric; fruits of amla (*Emblica officinalis*), haritaki (*Terminalia chebula*), bohera (*Terminalia belerica)* and bulbs of garlic (*Allium sativum*) of indigenous origin were determined. Proximate and mineral components [Calcium (Ca), Phosphorus (P), Sodium (Na), Potassium (K), Magnesium (Mg), Copper (Cu), Zinc (Zn), Manganese (Mn)] were determined. Dry matter (DM) varied from 964g/kg in arjun leaves to 892g/kg in tulsi leaves. Sajna leaves were high in protein (240g/kg), whereas haritaki fruits were low (34g/kg). Highest amount of ether extract (EE) was found in turmeric rhizomes and the lowest in amla fruits. The crude fibre (CF) ranged from 134 g/kg in turmeric leaves to 7g/kg in garlic bulbs. Highest amounts of ash were found in tulsi leaves (136g/kg), whereas haritaki had 42g/kg. All the plant products had high Nitrogen Free Extract (NFE) and haritaki ranked the highest. Neem leaves contained the highest amount of Ca and Mg. Fruits had lower amounts of P than other products. K content ranged between 8510 ppm in turmeric leaves and 4190 ppm in arjun leaves. Tulsi leaves contain higher amounts of Na, whereas arjun leaves contained less. Tulsi leaves contain higher amount of Cu and Zn than other plant products. The Mn content ranged from 17 ppm in ginger to 780 ppm in garlic bulbs. Only sajna and neem leaves are considered as fair sources of protein. Such ingredients may be considered as good sources of Ca and Mg. (*Bangl. vet*. 2008. Vol. 25, No. 1, 32-39)

Introduction

The leaves, roots, bark and fruits of medicinal plants in Bangladesh have various health-promoting effects on man and animals. These materials may be suitable singly or in combination as therapeutic agents and are important raw materials for manufacturing traditional and modern medicines. Substantial amounts of foreign exchange can be earned by exporting commercial products of medicinal plants. Indigenous medicinal plants have been playing a significant role in the economy of Bangladesh.

Neem (*Azadirachta indica*) is a useful traditional medicinal plant in Bangladesh. Each part of the neem tree has some medicinal properties and is commercially exploitable for the development of medicines and industrial by-products.

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The fruits of sajna (*Moringa oleifera*) are used in hepatitis and spleen inflammation, arthritis, tetanus and paralysis. The leaves possess antihypertensive activity (Ghani, 2000).

Arjun (*Terminalia arjuna*) is used in the treatment of glositis, chelitis and gingivitis (Ghani, 2000).

The extract of tulsi (*Ocimum sanctum*) leaves is hypoglycaemic, immuno-modulatory, anti stress, analgesic, antipyretic, anti-inflammatory, anti-ulcerogenic, antihypertensive, radio-protective, anti-tumour and antibacterial (Das and Vasdevan, 2006).

Turmeric (*Curcuma longa*) is a well-known remedy in ancient Indian medicine and in cosmetics. It serves as a remedy for practitioners of Ayurveda, Siddha, Unani and traditional Chinese medicine. Turmeric is used to treat asthma, dysmenorrhoea, psoriasis, eczema, arthritis, hepatic and digestive disorders and to prevent cardiovascular diseases (Sakarkar *et al.*, 2006).

Ginger (*Zingiber officinale*) has antibacterial, antifungal, antiparasitic, antiviral, anti-diabetic, anti-inflammatory, antioxidant and anti-hypercholesterolaemic properties (Saeed and Tariq, 2006).

Amla (*Emblica officinalis*) improves memory, lowers cholesterol and has anticholinesterase activity (Vasudevan and Parle, 2007).

Haritaki (*Terminalia chebula*) fruits are used in the treatment of indigestion, constipation, dysentery, jaundice, piles, dysmenorrhea. lacrimation, chronic ulcers and wounds (Chopra *et al*., 1956).

Garlic (*Allium sativum*) is utilized as a dietary component and as a substrate for the production of medicines. Garlic possesses strong antimicrobial properties (Baasinska and Kulasek, 2004).

Bohera (*Terminalia belerica)* a large and tall deciduous tree, *Terminalia belerica,* locally known as *Bahera* or *Boyra* of the family Combretaceae. It grows in the forests of the Chittagong hill tracts (http://banglapedia.search.com.bd/HT/C_0215.htm), and in the Sal forest regions of Dhaka, Tangail, and Mymensingh. The fruits are commonly and largely used in indigenous medical purposes. The pulp of the fruit is used in treating diarrhoea and leprosy. Half-ripped fruits are used as purgative. The oil extracted from the seeds is useful as a hair tonic (http://d.scribd.com/docs/w4cjupzwj8xvb6m83ra.pdf).

Although, the medicinal properties of these plant products are well recognized, data with regard to their chemical composition are scanty. It is necessary to evaluate the chemical composition of those plants in addition to their components that promote health care. The purpose of this study was to evaluate the proximate (DM, CP, CF, EE ash and NFE) and mineral compositions (Ca, P, Na, K, Mg, Mn, Cu and Zn) of selected medicinal plant products.

Materials and Methods

Collection of sample

The leaves of neem, arjun, and turmeric were collected from trees grown at the university campus. The leaves of sajna and tulsi and the rhizomes of turmeric, ginger and bulbs of garlic were collected from the local market of Brahmanbaria district. Bohera, amla and haritaki fruits were collected from Kamal Ranjit Market of the campus.

Preparation of samples

After collection, the leaves were sun-dried and ground with a hand grinder. The rhizomes and bulbs were sliced, sun-dried and ground. The kernels of fruits were removed, sun-dried and ground.

Analytical methods

The proximate analysis was carried out for each sample in triplicate for DM, CP, Crude Fat, CF, ash and NFE according to the Official Methods of Analysis (AOAC, 1990). Ca, P, Na and K concentrations were measured following the methods of Jackson (1973). Mg concentrations were estimated by following methods as described by Page *et al.* (1982). Determination of Mn, Cu and Zn was done following the method of Mclaren *et al.* (1984).

Statistical analysis

Means and standard deviations were calculated for three independent determinations for each variable.

Results and Discussion

Proximate composition

Proximate composition of plant products is shown in Table 1. Arjun leaves contained higher DM than tulsi leaves. The EE content varied from 11.3g/kg in haritaki fruits to 123.4 g/kg in turmeric rhizomes.

The CP content was highest in sajna leaves (240.4g/kg), and lowest in haritaki fruits (33.6g/kg). CF values varied from 7.3g/kg in garlic bulbs to 133.9g/kg in turmeric leaves. Ash content was highest in tulsi leaves and lowest in garlic bulbs. NFE content was highest in haritaki fruits and lowest in neem leaves (Table 1)

Proximate composition of neem leaves

DM of neem leaves was very close to the earlier observation of Esonu *et al.* (2005) who reported 924.2g/kg on air dry basis. DM contents were much lower in some studies (Bais *et al.*, 2002; Chaudhary *et al.*, 1999; Vietmeyer, 1992). These deviations probably resulted from nature of samples, type and age of plant and processing technique after harvesting.

EE content of neem leaves was close to the reports of Chaudhary *et al.* (1999) and Majumdar *et al.* (1965) who found 38.1g/kg and 34.9g/kg, respectively. Bais *et al.*

(2002) and Vietmeyer (1992) reported lower values of 24.20g/kg and 24.6g/kg, respectively. Sonaiya and Olori (1989) reported 42.0g/kg, which was slightly higher than that obtained in the current study. These variations might have resulted from varietal differences and/or maturity of the plants.

CP content of neem leaves was similar to that of Majumdar *et al.* (1965) and Bais *et al*. (2002), who found 182.7g/kg and 186.7g/kg, respectively. On the other hand, Sarker (2004), Sonaiya and Olori (1989) and Vietmeyer (1992) reported 175.0g/kg, 175.0 g/kg and 174.8g/kg (DM basis), respectively, close to the values of the current study. Chaudhary *et al.* (1999) reported 159.6g/kg. Variations in protein content might occur due to maturity. Crude fibre level in neem leaves was close to the value of Majumdar *et al*. (1965) and Sonaiya and Olori (1989), who reported 120.7g/kg and 123.0 g/kg, respectively. Higher values were reported by others (Bais *et al.,* 2000; Chaudhary *et al*., 1999; Sarker, 2004; Vietmeyer, 1992). Ash content of neem was very close to the observation of Majumdar *et al*. (1965) who reported 138.6g/kg. The ash content differed from the result of Sarker (2004) who measured 72.0g/kg. Nitrogen free extract content of neem leaves was similar to that of Vietmeyer (1992), who reported 564.0g/kg. On the other hand, Chaudhary *et al*. (1999) reported 496.3g/kg NFE, which was slightly lower than the value obtained in this study.

Proximate composition of sajna leaves

EE content of sajna leaves was close to that of Majumdar *et al.* (1965) and other authors (http://www.fao.Org/ docrep/field/ 003/P8348E/ P8348E01.ht), who found 74.5g/kg and 69.0g/kg, respectively. CP content of sajna leaves is comparable to Majumdar *et al*. (1965) and other authors (http://www. fao. org/docrep/field/003/ P8348E/ P8348E01.ht), who reported 206.7g/kg and 266.0 g/kg, respectively.

Crude fibre content of sajna leaves was 17.7g/kg, but Majumdar *et al.* (1965) reported 71.2g/kg, which was much higher. Majumdar *et al.* (1965) reported that CP reached its peak with the emergence of new foliage, when crude fibre content decreased. They stated that the leaves were fairly rich in ether extract, particularly in the mature stage.

Ash content of sajna leaves was close to that of Majumdar *et al.* (1965) and other authors (http:// www.fao.Org/ docrep/ field/ 003/ P8348E/ P8348E01.ht), who 118.0g/kg and 91.0g/kg, respectively. NFE content of sajna leaves was similar to value of a previous report (http://www.fao.org/ docrep/ field/ 003/ P8348E /P8348E01.ht).

Proximate composition of garlic (Allium sativum) bulbs

The moisture content of garlic was comparable to the values reported in the Encyclopedia of Chemical Technology (1980), Nwinuka *et al.* (2005) and by others (http://www. brineshrimpdirect. com/c1/c4/Garlic-Plus-c25.html; http:// www. brineshrimpdirect. Com/flake-garlic-C127.html). Ether extract content of garlic was comparable to the values of 6.0g/kg and 6.8g/kg indicated in Encyclopedia of Chemical Technology (1980) and Nwinuka *et al.* (2005), respectively. CP content of garlic was similar to Nwinuka *et al.* (2005) and that in Encyclopedia of Chemical Technology (1980), which gives 173.5g/kg and 175.0g/kg, respectively. On the other hand, higher protein content was reported by other authors (420.0g/kg, 450.0g/kg; http://www. brineshrimpdirect.com/ c1/c4/ Garlic- Plus- c25.html; http://www.brineshrimpdirect.Com/flake-garlic-C127. html). The wide differences in CP content in garlic might have resulted from differences in varieties and processing techniques. The ash content of garlic was a little higher than the value reported by Nwinuka *et al* (2005). Higher values of 70.0g/kg and 50.0g/kg have been reported (http://www.brineshrimpdirect.com/c1/c4/Garlic-Plus-c25.html; http: //www. Brineshrimpdirect. Com/ flake-garlic-C127.html).

Table 1. Proximate composition of some indigenous medicinal plant products

Plant products	Air dry basis (g/kg)	DM basis (g/kg)				
	DM	EE	CP	CF	Ash	NFE
Neem (*Azadirachta indica*) leaves	938.9 ± 0.16	35.3 ± 0.08	181.6 ± 1.46	113.3 ± 0.86	130.7 ± 0.07	539.1 ± 0.88
Sajna (*Moringa oleifera*) leaves	913.0 ± 0.00	63.3 ± 0.30	240.4 ± 0.30	17.7 ± 0.36	101.3 ± 0.02	577.3 ± 0.10
Arjun (*Terminalia arjuna*) leaves	964.2 ± 0.53	26.3 ± 0.05	129.0 ± 0.65	99.1 ± 0.37	87.8 ± 0.01	657.8 ± 0.42
Tulsi (*Ocimum sanctum*) leaves	891.5 ± 3.32	29.0 ± 0.01	174.5 ± 1.23	90.7 ± 0.48	135.6 ± 0.06	570.2 ± 0.56
Turmeric (*Curcuma longa)* leaves	952.6 ± 0.98	16.9 ± 0.44	139.4 ± 0.17	133.9 ± 0.54	119.5 ± 0.00	590.3 ± 0.71
Ginger (*Zingiber officinale*) rhizomes	962.4 ± 0.56	76.5 ± 0.33	118.8 ± 0.27	98.8 ± 0.64	110.6 ± 0.14	595.3 ± 1.14
Turmeric (*Curcuma longa*) rhizomes	934.9 ± 0.09	123.4 ± 0.43	117.5 ± 0.19	42.9 ± 0.25	74.4 ± 0.09	641.8 ± 0.82
Garlic (*Allium sativum*) bulbs	934.3 ± 0.30	32.8 ± 0.26	175.5 ± 0.96	7.3 ± 0.20	33.1 ± 0.08	751.3 ± 0.10
Amla (*Emblica officinalis*) fruits	944.0 ± 0.08	13.5 ± 0.13	53.1 ± 0.21	89.4 ± 1.01	67.8 ± 0.08	776.2 ± 0.45
Haritaki (*Terminalia chebula*) fruits	922.3 ± 0.11	11.3 ± 0.14	33.6 ± 0.10	104.7 ± 0.78	42.3 ± 0.04	808.1 ± 0.81
Bohera (*Terminalia belerica*) fruits	956.1 ± 0.11	11.9 ± 0.26	78.3 ± 0.31	86.6 ± 0.10	47.3 ± 0.03	775.9 ± 0.66

Values indicate mean ± standard deviation of triplicate analyses

Proximate composition of ginger (Zingiber officinale) rhizomes

The moisture, CP, EE and ash concentrations were comparable to the values reported by Nwinuka *et al.* (2005; 66.7g/kg, 85.8g/kg, 55.3g/kg and 64.0g/kg, respectively). The moisture, CP, CF and ash were comparable to the values in the Encyclopedia of Chemical Technology (1980) (69.0g/kg, 86.0g/kg, 64.0g/kg and 57.0g/kg, respectively). The values for EE and CP were in agreement with those of Meadow (1988; 152.1g/kg, 83.9g/kg, respectively).

The composition of tulsi leaves, turmeric leaves, arjun leaves, turmeric rhizomes, bohera fruits, amla fruits and haritaki fruits is hitherto unknown.

Mineral composition

The highest Ca content was found in neem leaves, and the lowest in garlic (Table 2). The P content was highest in ginger, and lowest in bohera. The fruits contained less P than leaves or rhizomes. Highest amount of Mg was found in neem, and lowest amount in garlic bulbs. The Mg value ranged from 0.194 to 1.260 ppm. Turmeric leaves contained highest amount of K (8510 ppm), and arjun the lowest (4190 ppm). Highest amount of Na was found in tulsi and the lowest in arjun. The leaves and rhizomes of turmeric had similar values. The concentrations of Cu and Zn were highest in tulsi leaves, and lowest in garlic bulbs and bohera fruits, respectively. Highest amount of Mn was found in ginger rhizomes and lowest in garlic bulbs. The amounts of Cu, Zn and Mn of sajna leaves are similar to the result of Aslam *et al.* (2005), who found 7.3-11.2, 20.9-34.1 and 76.9-112.8 mg/kg, respectively.

Table 2. Mineral composition of some indigenous medicinal plant products

Plant products	Composition (ppm)							
	Ca	P	Mg	K	Na	Cu	Zn	Mn
Neem (*Azadirachta indica*) leaves	1.48	10.55	1.26	7230	190	5.24	47.74	30.41
Sajna (*Moringa oleifera*) leaves	0.84	10.05	0.93	6550	180	6.08	28.50	112.52
Arjun (*Terminalia arjuna*) leaves	0.76	11.60	0.86	4190	140	6.37	51.00	61.50
Tulsi (*Ocimum sanctum*) leaves	1.00	10.90	1.05	5260	680	12.31	81.66	51.35
Turmeric (*Curcuma longa)* leaves	0.64	11.05	0.96	8510	220	7.04	38.68	216.37
Turmeric (*Curcuma longa*) rhizomes	0.12	10.25	0.28	7940	210	5.71	57.06	428.93
Ginger (*Zingiber officinale*) rhizomes	0.04	11.65	0.36	5630	170	5.06	56.24	780.30
Garlic (*Allium sativum*) bulbs	0.00	11.45	0.19	5330	160	4.81	41.42	17.08
Amla (*Emblica officinalis*) fruits	0.12	8.70	0.28	6190	180	5.95	38.06	207.83
Haritaki (*Terminalia chebula*) fruits	0.08	7.00	0.28	6610	170	7.31	21.16	34.60
Bohera (*Terminalia belerica*) fruits	0.12	5.15	0.38	6660	170	5.85	12.88	51.46

Reports on mineral composition of medicinal plant products are lacking. It is not possible to relate the results with others. The data generated may be useful in exploring medicinal properties of individual plant products. The next steps would be to determine the active principles of these medicinal plant products and to conduct feeding trials with the objective of exploiting their potential benefit on health and production.

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