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Minerals and nutritional composition of radhuni (*Carum roxburghianum* Benth.) seeds

[1]Paul, B. K., [2,3]Saleh-e-In, M. M., [3]Ara, A. and [2*]Roy, S. K.

[1]*Department of Chemistry, Jagannath University, Dhaka-1100, Bangladesh,*
[2]*Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka-1205, Bangladesh,*
[3]*Department of Chemistry, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh.*

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Abstract

Radhuni (*Carum roxburghianum* Benth.) seeds of three indigenous cultivars grown in Bangladesh have been studied for minerals and various compositional properties as well as assess their role in human nutrition. Variability was observed among investigated cultivars in terms of physical characteristics (e.g. seed volume, seed density, hydration capacity, hydration index, swelling capacity and swelling index), proximate analysis (e.g. total ash, water soluble ash, acid insoluble ash, crude fiber, protein, carbohydrates and food energy) and mineral composition. The mineral compositions were determined by wavelength dispersive X-Ray fluorescence (WDXRF) technique. The significant amount of major mineral concentration were measured between 15879.30-17526.79 mg/kg Ca, 7627.433-8566.09 mg/kg Si, 5690.597-6428.60 mg/kg K, 2688.295-3162.62 mg/kg Fe, 2240.406-2498.74 mg/kg Mg, 2108.91-2368.93 mg/kg Al, 1035.71-1340.482 mg/kg S, 472.77-541.66 mg/kg Cl and 395.586-431.313 mg/kg Na. Co, Cd, As, Pb and Hg were not detected as toxic elements in the present analysis technique. The data showed that, in terms of both quality and quantity, the Radhuni seeds of Bangladeshi cultivars as significant source of nutritional and minerals supplement to meet the dietary contents as well as to help the formulation of herbal medicinal preparations.

Introduction

During the last century, herb and spice have been used in culinary practices and also in traditional therapeutic practices for the treatment of different types of ailments. The nutritional and medicinal properties of the plants may be inter-linked through phytochemicals, both mineral and nutrient constituents. *Carum roxburghianum* (DC) Craib and Benth (Local name Radhuni) is a spice, aromatic and medicinal plant, comes under genus Carum out of 192 species and belonging to the family *Apiaceae* (*Umbelliferae*). It is native to tropical Asia, Africa and also cultivated in Bangladesh, India, Pakistan, China and Indonesia (Minosuke, 1958; Anonymous, 1976; Heinrich *et al*., 2003; Solomon *et al*., 2011). The pharmacological evidences shows, it's use in traditional system of medicine to treat diarrhea, abdominal spasm (colic), asthma, bronchitis cough, common cold, dyspepsia, lethargy, loss of consciousness, palpitation, vomiting, pain in bladder and kidneys as well as considered useful as anthelmintic, antigout, antimicrobial, cardiotonic, carminative, condiment, digestive, emmenagogue, stimulant and stomachic (Khan *et al*., 2012). Phytochemical studies on the plant revealed the presence of most important components in the seed and leaf essential oil. They are limonene sabinene, terpinen-4-ol, (Z) logustilide, γ-terpinene, menthol, citronellal 3,6-dimethyl-2,3,3a,4,5,7a-hexahydro-benzofuran, citronellol, geraniol, benzene, 1-methoxy-4-(1-propenyl) phenol, 2-methoxy-4-(1-propenyl) α-terpinene, dipentene, d-linalool and terpineol. Moreover, seed and leaf essential oils are used as a fragrance and flavoring agent in cosmetics and food industries (Malavya *et al*., 1942; Chowdhury *et al*., 2000; Chowdhury *et al*., 2009).

The nutritionist and the food scientist have got increased interest in *Carum roxburghianum* in the nutritional point of view. At present, traditional medicinal herbs are used for strengthening the body immune system which is known to have many essential and nutritional elements (Lokhande *et al*., 2009). The nutritional and medicinal properties of the plant may be inter-linked through phytochemicals, both nutrient and non-nutrient (Ozcan *et al*., 2007). Since its seed and plant has been used to food flavoring and herbal treatment, it is important to know their elemental contents because some of these elements have either toxic effects or essential properties. Their excess or deficiency of the elements may disturb normal biochemical functions of the body (Macrae *et al*., 1993a; Rajurkar *et al*., 1997; Gupta *et al*., 2000; Cennet *et al*., 2012).

*Corresponding author.
Email: *saleheen_sosthe@yahoo.com*

Several phytochemical and pharmacological researches have been carried out on *C. roxburghianum*. But, reports related to nutritional contents and analyses of the elemental composition by modern XRF technique are still limited. In our continuous research work on the spice and medicinal plants, we have reported the elemental composition by modern XRF technique along with nutritional composition through proximate analysis of *Carum roxburghianum* seed which is growing in Bangladesh.

Materials and Methods

Plant material

Radhuni seeds were collected from Regional Spice Research Center at Gazipur (Jaydebpur), in Dhaka (Keranigonj) and Regional Spice Research Center at Faridpur districts of Bangladesh. The collected brownish green seeds samples were hand-cleaned to render them free of dust, others specimen, air-dried in room temperature and then stored in air-tight opaque high-density double lined polyethylene bag at room temperature until analysis.

Physical characteristics of the seeds

A reported procedure (Khattak *et al*., 2006; Zia-Ul-Haq *et al.*, 2007) was followed for determining physical measurements of Radhuni seeds with three replications. Seed volumes were determined by transferring 1 g. Radhuni seed sample in a 10 mL measuring cylinder and recorded the volume. Then 5 mL distilled water was added to it and recorded the volume again. The gained volume was divided by seed weight and it was taken as the seed volume. Seed density was calculated as seed weight divided by seed volume. Hydration capacity was determined by transferring 1 g Radhuni seed sample in 10 mL measuring cylinder with 5 mL distilled water and allowed for overnight soaking. The adhering water on seed surface was removed by tissue paper and the gained weight was taken. Hydration index was calculated as hydration capacity divided by original seed weight. The swelling capacity was determined as gain in volume after overnight soaking in water, and swelling index was calculated as swelling capacity divided by original seed volume.

Proximate analysis

The proximate parameters were determined according to standard methods (BP, 2004; AOAC, 2005) with three replications. The gross food energy (FE) was estimated as kcal/100 g using the equation: FE = (% Crude Protein ×4) + (% Fats and oils percentage ×9) + (% Charbohydrate ×4).

XRF samples preparation

Dried seed powder samples were burned to ashes at 400 ± 50˚C temperature until constant weight. The ash powder samples were mashed to below 100 µm. by using planetary ball mill (PM-200, Retsch, Germany). They were mixed using a SPEX mill having 25 mL stainless steel cup and balls after sieving process. Then they were dried in an oven at 110 ± 5^{o}C to remove moisture before analyses. The moisture contents were also recorded. The ash samples were mixed with binder (stearic acid: sample = 1:10), pulverized and then pressed into uniform pellets of 20 mm diameter using a hydraulic press machine (SPEX Pmax=10 tons/inch^2.) for 2 minutes.

XRF pre-analytical data of ash samples

R.M.S. = 0.00, Sum before normalization: 50.6% (Gazipur–Joydebpur sample) and 60.60% (Dhaka-Keranigonj and Faridpur sample), Normalized to: 99.99%, Used compound list: Oxides, Results database: iq+.

Instrument parameter of XRF spectrometer

The Wavelength Dispersive XRF spectrometer (Rigaku ZSX Primus) characteristics included:

i) *General*: Elemental coverage: Be through U, Optics: Wavelength-dispersive, sequential,
Tube below.
ii) *X-ray generato*r: X-ray tube: 3kW, 60kv, 100 and 60 mA (in steps), end window, Rhodium target X-ray anode, HV power supply: High frequency inverter, ± 0.005% stability.
iii) *Spectrometer*: Sample changer: 48 positions (standard), expandable, Analysis sample area: 35 mm (diameter), Sample rotation speed: 30 rpm, Primary X-ray filters: Al, Ti, Cu, Zr and Be (optional, for window protection), Beam collimators: 6 auto-selectable diameters: 35, 30, 20, 10, 1 and 0.5 mm, Divergence slit: 3 auto-selectable: standard, high, and course (optional) resolutions, Maximum scan speed: 1400°/min (2θ), Continuous scan: 0.1-240°/min, Crystals: LiF1 for Ca, Ti, Cr, Mn, Fe, Ni, Cu, Zn, Br, Rb, Sr, Zr, Nb and Ba; PET for Al and Si; Ge for P, S, Cl and K, RX25 for Na and Mg, automatic mechanism, Quench gas: P10 gas (is normally 90% Ar and 10% CH_4), gas output pressure 80 Kpa, Minimum Detection Limit is 1 ppm.
iv) *Detector systems*: Heavy element detector: Scintillation Counter (SC), Light element detector: Flow, Proportional Counter (F-PC), Attenuator: In-out automatic exchanger (1/10).
v) *Software*: Multi-window, multi-function, fundamental parameters.

Data analysis

Statistical analyses of all data were performed by means of MS Excel version 7 software. Results were expressed as mean value ± standard deviation (n = 3) of three separate determinations. The significant differences ($P < 0.05$) of the mean values were also calculated by MS Excel version.

Results and Discussion

Physical characteristics

Physical characteristics of Radhuni seeds (Table 1) showed considerable variations among the cultivars which were not reported earlier. Dhaka (Keranigonj) had the highest seed density (1.0187 g/mL), swelling index (0.500567) while Faridpur had the lowest (0.8797 g/mL and 0.3885 respectively). Faridpur cultivar excelled over other cultivar in terms of seed volume (1.2096 mL/g), hydration capacity (0.7755 g) and hydration index (0.7289) and the same was true for swelling capacity (0.4699 mL/g) where Gazipur Jaydebpur and Dhaka Keranigonj had the least swelling capacity (0.3967 mL/g), seed volume (0.9908 mL/g), hydration capacity (0.6015 g) and hydration index (0.596) respectively. The difference observed may be due to variety, cultivar and agronomic practice difference. This result may be helpful to measure the physical quality standard parameters of the seed quality by comparing to other geographical variety and cultivar.

Table 1. Physical characteristics of *Carum roxburghianum* (Radhuni) seeds

Parameter	Dhaka (Keranigonj)	Gazipur (Jaydebpur)	Faridpur
Seed volume (mL/g)	0.9908±0.0002	0.9918±0.0004	1.2096±0.0003
Seed density (g/mL)	1.0187±0.0002	1.0166±0.0006	0.8797±0.0002
Hydration capacity (g)	0.6015±0.0002	0.7026±0.0002	0.7755±0.0002
Hydration index	0.596±0.0003	0.6969±0.0004	0.7289±0.0005
Swelling capacity (mL/g)	0.4953±0.0001	0.3967±0.0004	0.4699±0.0005
Swelling index	0.500567±0.0012	0.3999±0.0003	0.3885±0.0005

Each value is average ± SD, n = 3, $p < 0.05$ (95% confidence interval) on fresh weight basis.

Proximate analyses

Proximate composition of Radhuni seeds are presented in Table 2. The moisture contents of the collected seed found the highest (11.60%) in Faridpur and the least in Gazipur (Jaydebpur) (9.8%) which were higher than the earlier reported (Poonam *et al.*, 2012) data (5.04%). There is no significance difference were observed among the varieties in the ash content which observed high (9.01%) in Dhaka (Keranigonj) and low (8.24%) in Faridpur samples. This result marked higher than the reported (Poonam *et al*., 2012) value (4.7%). The ash value indicates the high mineral content in the sample. Dry and organic matter contents were calculated by difference from moisture and ash value respectively. The protein and nitrogen content significantly higher (3.58% and 22.37% respectively) in Gazipur (Joydebpur) than the other cultivars, while Dhaka (Keranigonj) had the lowest (2.96% and 18.5% respectively). The crude protein content compared favorably with seeds and legumes of Cowpea (22.7%), Lima beans (19.8%) and Chickpea (19.0%), (Oshodi, 1993). Fatty oil and food energy were the highest (20.32% and 336.085 kcal/100 g respectively) in Dhaka (Keranigonj) while Gazipur had the lowest (15.30% and 317.72 kcal/100 g respectively). In addition, the oil content was comparable with other spice seed oil like Coriander seed oil (21.5%), Basil seed oil (18-26%) and other vegetable oil seed like Soy bean oil (19-21%), Cotton seed oil (15-20%) and Rice bran oil (10-26%) (Banshi *et al.*, 1992; Ching, 2000). Among the cultivars, both acid in-soluble and water soluble ash content were found the highest (4.16% and 2.48% respectively) in Faridpur cultivar where literature reported (Poonam *et al*., 2012) value was 0.249% for acid in-soluble ash. Acid in-soluble ash value is an indicative silicate impurity and water soluble ash content indicated the highly soluble mineral contents in the sample. Carbohydrate content and crude fibre were present the highest 22.63 % and 23.93% in Gazipur (Joydebpur) and Faridpur sample respectively and their lowest values were vice-versa in same cultivar. Protein, crude fibre and carbohydrate contents are the important from the nutritional point of view. Dietary fibre is known to influence digestion and absorption processes in the small intestine (Cherbut *et al.*, 1995; ASP, 1996). The high protein and oil content makes the seed as a potential source of commercial

Table 2. Proximate parameter of *Carum roxburghianum* (Radhuni) seeds (in per cent)

Parameter	Dhaka (Keranigonj)	Gazipur (Jaydebpur)	Faridpur
Moisture	10.71±0.01	9.80±0.017	11.60±0.01
Dry Matter	89.29±0.01	90.20±0.01	88.40±0.01
Total ash	9.01±0.01	8.99±0.01	8.24±0.01
Acid in-soluble ash	4.09±0.00	3.59±0.00	4.16±0.001
Water soluble ash	2.09±0.00	1.74±0.003	2.48±0.01
Organic matter	90.99±0.01	91.01±0.01	91.76±0.01
Crude fiber	21.66±0.01	20.90±0.06	23.93±0.01
Nitrogen	2.96±0.01	3.58±0.03	3.26±0.01
Crude Protein	18.50±0.06	22.37±0.22	20.38±0.07
Fats and oil	20.32±0.01	15.30±0.02	20.23±0.01
Carbohydrates (by difference)	19.80±0.06	22.63±0.014	15.62±0.08
Food energy (Kcal/100g)	336.08±0.04	317.72±0.46	326.07±0.04

Each value is average ± SD, n = 3, $p < 0.05$ (95% confidence interval), % on fresh weight basis.

Table 3. Mineral constituents of *Carum roxburghianum* (Radhuni) seeds

Elements	Dhaka (Keranigonj)		Gazipur (Jaydebpur)		Faridpur	
	DB(%)	FB (mg/kg)	DB(%)	FB (mg/kg)	DB(%)	FB (mg/kg)
Na	0.509±0.00	409.459±2.38	0.532±0.00	431.313±5.34	0.543±0.00	395.586±2.70
Mg	3.003±0.01	2416.251±8.40	3.081±0.02	2498.741±17.63	3.075±0.03	2240.406±23.24
Al	2.704±0.02	2175.944±19.51	2.921±0.02	2368.937±22.70	2.895±0.00	2108.910±6.67
Si	10.05±0.02	8085.836±17.234	10.564±0.02	8566.09±20.05	10.470±0.04	7627.433±29.09
P	6.852±0.03	5512.752±30.00	7.114±0.01	5768.249±14.15	6.721±0.03	4895.909±26.02
S	1.666±0.01	1340.482±11.618	1.59±0.01	1289.276±11.70	1.422±0.01	1035.714±8.75
Cl	0.631±0.00	507.690±3.687	0.668±0.00	541.668±4.93	0.649±0.00	472.779±4.05
K	7.969±0.02	6412.030±17.671	7.928±0.03	6428.60±30.85	7.812±0.02	5690.597±21.80
Ca	21.784±0.03	17526.799±26.35	20.94±0.03	16980.206±26.55	21.798±0.04	15879.300±36.07
Ti	0.242±0.00	194.334±3.64	0.239±0.00	193.912±3.50	0.254±0.00	185.121±1.57
Cr	0.381±0.00	306.626±2.39	0.315±0.00	255.766±2.54	0.337±0.00	246.221±2.58
Mn	0.153±0.00	123.376±4.3617	0.127±0.00	102.991±2.87	0.134±0.00	98.166±1.69
Fe	3.93±0.02	3162.622±20.28	3.315±0.01	2688.295±11.34	3.693±0.03	2690.226±23.34
Ni	0.043±0.00	34.520±0.22	0.037±0.00	30.394±0.56	0.013±0.00	9.731±0.57
Cu	0.033±0.00	26.481±0.560	0.028±0.00	22.608±0.57	0.031±0.00	22.347±0.32
Zn	0.109±0.00	87.910±2.585	0.096±0.00	78.175±1.12	0.102±0.00	74.327±3.04
Br	0.005±0.00	4.586±0.625	0.005±0.00	4.135±0.11	0.005±0.00	4.006±0.20
Rb	0.042±0.00	33.917±0.520	0.041±0.00	33.514±0.41	0.043±0.00	31.241±0.23
Sr	0.046±0.00	37.351±0.336	0.042±0.00	34.009±0.48	0.046±0.00	33.756±0.43
Zr	0.011±0.00	9.113±0.168	0.011±0.00	9.304±0.21	0.011±0.00	8.305±0.26
Nb	ND	ND	0.002±0.00	1.394±0.06	ND	ND
Ba	ND	ND	0.076±0.00	62.023±0.10	44.302±0.00	44.302±0.27
O	60.166±0.01	32033.218±20.85	59.675±0.03	32621.98±19.29	60.078±0.04	29017.332±6.76
Ca/P	3.179	3.179	2.94	2.94	3.24	3.24
Na/K	0.063	0.063	0.067	0.067	0.069	0.069

DB (%) = percentage as g/100 g on dry weight basis from ash sample. FB (mg/kg)= calculated on fresh weight basis, n = 3, $p < 0.05$ (95% confidence interval) of DB samples.

vegetable oil and protein.

Elemental composition

WDXRF spectrometric analysis of Radhuni seed elements were presented in Table 3. In the experiment, nine minerals (Ca, Na, Mg, Al, Si, P, S, K and Ti), twelve trace elements (Mn, Fe, Cu, Zn, Ni, Br, Sr, Cr, Ba, Rb, Zn and Nb) and other type of element like Cl have been reported in the three different cultivars. The concentrations were calculated as mg/kg on the fresh weight basis (FB). Mineral of Ca (17526.799 mg/kg) found the highest level in Dhaka (Keranigonj) than those of other minerals. Si (8566.09 mg/kg), K (6428.60 mg/kg) P (5768.249 mg/kg), Mg (2498.741mg/kg), Al (2368.937 mg/kg) and Na (431.313 mg/kg) were the highest in Gazipur (Jaydebpur), hence the same were the lowest in Faridpur cultivar. Moreover, Ti (194.334 mg/kg) was the highest in Dhaka (Karigonj) and the lowest (185.21 mg/kg) in Faridpur cultivar.

On the other hand, among the cultivars trace elements such as Fe (3162.6222 mg/kg), Cr (306.626 mg/kg), Mn (123.376 mg/kg), Zn (87.910 mg/kg), Sr (37.35 mg/kg), Rb (33.917 mg/kg), Ni (34.52 mg/kg), Cu (26.481 mg/kg) and Br (4.586 mg/kg) were the highest level in Dhaka (Keranigonj), whereas Faridpur had the lowest value of the said elements except Fe. It was found lowest in Gazipur (Jaydeppur) (2688.295 mg/kg). Ba (62.023 mg/kg) and Zr (9.304 mg/kg) were the highest in Gazipur (Jaydebpur) and the lowest (44.3002 and 8.305 mg/kg respectively) in Faridpur, whereas Ba was absent in Dhaka (Keranigonj). Very trace amount of Nb was present only in Gazipur (Jaydebpur). The toxic

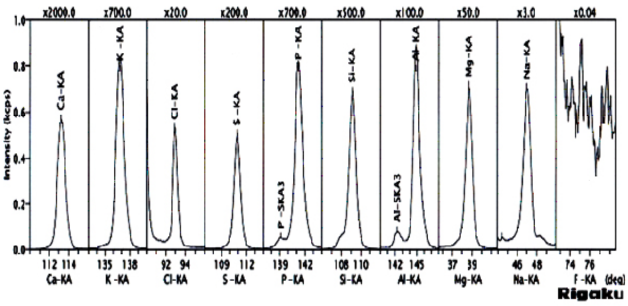

Figure 1. The typical XRF spectrum of Ca, K, Cl, S, P, Si, Al, Mg and Na.

elements Cd, Pb, As and Hg were not detected in that experimental technique. The typical XRF spectrum was presented in Figure 1.

Comparative data of total mineral, trace elements and other type of elements of three cultivars were presented in Table-4, Figure 2 and Figure 3. The results showed that the mineral and trace elemental concentrations were found the highest level in Gazipur (Jaydebpur) and Dhaka (Keranigonj) respectively. In contrast, the most of the elements found the lowest level in Faridpur cultivar. This variation is depending on various factors, e.g. cultivar, maturity stage, environment (weather conditions) and agro-techniques (Zia-ul-Huq *et al.*, 2007).

Reference data of the elemental contents for the Recommended Dietary Allowance (RDA) for adult, Recommended Dietary Allowance (RDA) for infant and Maximum Level of Daily Intake (MLDI) without detriment to health for adult are shown in Table-5. The result indicates that the concentrations of the elements are within the safety baseline limit and could be considered as mineral and trace element supplement. The present study is comparable with

Table 4. Total elemental concentration: considering minerals, trace and other elements of *Carum roxburghianum* (Radhuni) seeds

Cultivars	Mineral Elements		Trace Elements		Other Element (Cl)	
	DB	FB	DB	FB	DB	FB
Dhaka (Keranigonj)	54.53	44073.88	4.75	3826.50	0.63	507.69
Gazipur (Jaydebpur)	54.67	44525.32	4.09	3322.60	0.66	541.66
Faridpu	54.73	40058.97	4.48	3262.62	0.64	472.77

Elements expressed DB (% on dry weight basis) and FB (mg/kg on fresh weight basis.

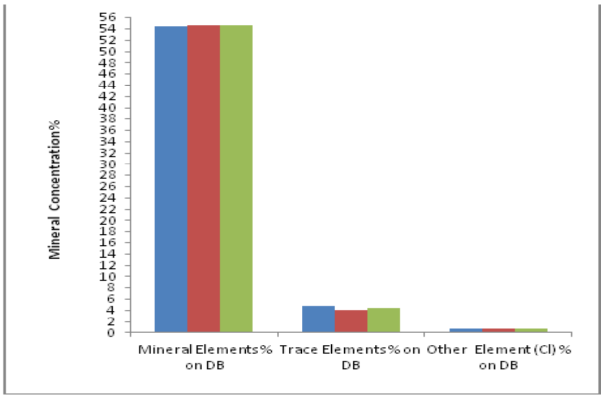

Figure 2. Elements concentration in % on Dry weight Basis (DB) of three cultivars

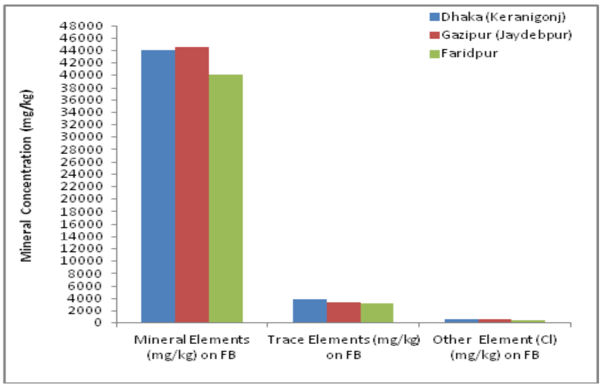

Figure 3. Elements concentration in mg/kg (ppm) on Fresh weight Basis (FB) of three cultivars

some selected spices which was reported by Gupta *et al.* (2003), Ozcan *et al.* (2004 and 2007). Ca for Carum (16960 mg/kg) & Basil, 15759.92 mg/kg, K for Black cumin (5626.25 mg/kg) & Mustard (6155.42 mg/kg), P for Bitter Fennel (5746.82 mg/kg), Cumin (5030 mg/kg) & Anise (5300 mg/kg), Fe for Cumin (2800 mg/kg) & Carum (3200 mg/kg), Mg for Balm (2692.99 mg/kg), Bitter Fennel (2496.72 mg/kg) & Fenugreek (2310 mg/kg), Al for Cumin (2100 mg/kg), Mn for Black Pepper (129.66), Zn for Carum (76.66) and Nigella (72.62 mg/kg).

Modern diets which are rich in protein and phosphorus may promote loss of calcium in the urine (Shill and Young, 1988). This has led to the concept of the Ca/P ratio. When Ca/P is low, abnormal quantity of calcium is lost in the urine. Thereby reducing the level of calcium in the body (Ogungbenle, 2011). According to Niemann et al. (1992) stated that the

Table 5. Mineral elemental compositions range of Radhuni seed of the present study and compared to recommended dietary allowance

Mineral Elements	Present study (mg/kg on fresh weight basis)	Recommend dietary allowance/Adequate daily dietary intake for adult human (mg/day)[a]	Recommend dietary allowance/Adequate daily dietary intake for infants (mg/day)[a]	Maximum level of daily intake without detriment to health for adult human (mg/day)[a, b]
Na	395.58-431.31	1500	120-370	2300
Mg	2240.40-2498.74	320-420	75	500
P	4895.90-5768.249	800	275	4000
CI	472.77-541.66	2300	180-570	3600
K	5690.59-6428.60	4700	400-700	ND
Ca	15879.30-17526.79	1000-1200	270	2500
Al	2108.91-2368.93	70	ND	36.4
Ba	44.30-62.023	ND	ND	16
Cr	246.22-306.62	25-35 (µg/d)	0.2-5.5(µg/d)	0.06
Fe	2688.29-3162.62	8-18	10	15
Zn	74.32-87.91	15	2-3	17
Cu	22.34-26.48	0.7-0.9	0.2-0.2.2	3.2
Mn	98.16-123.376	1.8-2.3	0.003-0.6	6-11
Ni	9.731-34.52	ND	ND	0.45
Ti	185.12-194.33	ND	ND	0.3
Sr	33.75-37.35	ND	ND	2.0

[a]Dietary Reference Intakes (www.nap.edu, 1997,2001,) ; [b]Senczuk, 1999
ND = Not determinable due to lack of data of adverse effects in this age group and concern with regard to lack of ability to handle excess amounts. Source of intake should be from food only to prevent high levels of intake.

ratio of $Ca/P \geq 1$ is considered as good food and $Ca/P \leq 0.5$ is considered as poor food. This suggested that Radhuni seed is nutritionally good spice (Ca/P) ratio = 2.94-3.24. The presences of Na/K in the body is useful for intercellular activities, maintenance of the osmotic balance of the body fluid, protect the body from excessive fluid loss and involved in the contraction of muscle cells and impulse conduction along nerve fibers (Lake and Waterworth, 1980). Na/K in the body is also useful in the prevention of high blood pressure. Na/K ratio 0.60 is recommended for an hypertensive patient (Niemann *et al.*, 1992). Na/K ratio of Radhuni seed is 0.063-0.069, which is not higher than 0.6. This indicated that it would inhibit high blood pressure. Other inorganic elements which may contribute to biological process, but which have not been established as essential, are barium and bromine. This work attempts to contribute to knowledge of the nutritional properties of this plant seed.

Conclusion

Elements are essential constituents of enzymes and play a significant role in human metabolism and are very important with regard to life process. Trace elements in spices may be correlated with their taste and adding spice in food not only increase flavor but also enhance its nutritive value by providing several essential nutrients in bio-available form. Moreover, excessive intake limit is the cause of the toxic effect (Ila and Jagun, 1980; Sing *et al.*, 2006). The WDXRF represents a good technique for analysis of biological samples including trace elements. This is the first approach for this spice to apply this technique. Twenty two elements were detected at various concentration levels. Na, Mg, K, Ca, P and Fe were found the rich amount of this plant seed. However, the data obtained in the present work will be considered as potential nutritional supplement due to its rich concentration of mineral, trace elements, carbohydrate, fiber and protein content and hence it might be helpful in the formulation of new Ayurvedic drugs and also the justification of their use as a good spice and in food industries.

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