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Elemental composition and heavy metals determination of some wetland plants of family polygonaceae

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Abstract

The wetland flora consists of important plant species which are used and consumed as food sources in several ways globally. Wetland plants also accumulates a small percentage of metals that can contribute to remediation of acidic, metal contaminated runoff waters from processing areas. Therefore, the current study was designed to examine the concentrations of various elements and heavy metals in four wetland plant species of family Polygonaceae i.e. *Rumex dentatus, Rumex hastatus, Polygonum aviculare* and *Persicaria glabra* collected from District Mardan, during 2016 and 2017. Elemental analyses of these species were carried out in the Central Resource Laboratory, University of Peshawar, Pakistan. The results revealed that *R. dentatus* was dominated by Cd, Zn, Cu, K elements. Further, *R. hastatus* was dominated by Co, Ca andmg. These wild plants are a good source of minerals as well as bio remediators. Furthermore, these plants have ethnobotanical importance i.e. *R. dentatus* and *R. hastatus* are mostly used as food while *P. aviculare* and *P. glabra* are important medicinal species.

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Introduction

About 4000B.C. old civilization record show that human of that time was using plants for different purposes. Babylon record show number of plants used as medicinal plants, such as Senna, coriander, saffron, cinnamon and garlic. Medicinal uses of plants have been found in documents of Egyptian culture. Georg Ebers in 3000B.C. give a great number of ancient Arab documents. The documents confined as a minimum 800 methods and about 700 therapeutic herbs of foreign and local origin that were known amongst the Babylonians, including absinth, aloe, peppermint, Indian hemp (cannabis), colocynth and opium poppy, garlic, juniper, Arabic gum, cumin and Ricinus seeds. Document left by Chinese emperor, Shen Nung 3000B.C., confined metaphors of plants including liquor ice, opium poppy, ergot, gentian, valerian and rhubarb. Many are in use currently. Medicinal plants uses are frequently stated in Indian system of Ayurveda, still these medicinal plants are used in traditional medicine (Paulsen, 2010). Many human disorders are treated using medicinal plants due to their effectiveness, availability, acceptability, affordability and low toxicity because they have active contents from natural origin (Shah, Ayaz, and Khan Au, 2013). Dietary and medicinal use and toxicity of plants rest on chemical and elemental composition. Heavy metals as micronutrients are present in all plants in trace or negligible amount, when its uptake become greater they contaminate the atmosphere leading to contaminated diet supply (Gholizadeh *et al.*, 2009). Such metals accumulate in body organs and persist there for long where they cause unwanted effects and toxicities as they have long half-lives (Iqbal *et al.*, 2013). In development, processing and growth plants are contaminated easily.

The use of chemicals and fertilizers causes heavy metal pollution. The contaminants and toxic metals should be controlled in plants as diet safety is chief health concern (Bempah *et al.*, 2012). Food web can be accumulated by heavy metals (Nedelkoska and Doran, 2000). Industrial and municipal wastelands are the origin of pollution of heavy metals (Banat *et al.*, 2005). Use of water for agriculture, industrial disposal waste and domestic purposes results in heavy metals, harmful chemicals and excess nutrients. Pollutants can accumulate in aquatic systems by human activities like landfill leachates, mining, industrial emissions, fossil fuels, vehicular emissions, agriculture run-off fertilizer erosion, pesticides, herbicides, municipal waste and sewage (Nyangababo *et al.*, 2005; Sekabira *et al.*, 2010), that are considered the safe site for polluted sediments disposal (Singh *et al.*, 1997). Extensive study of aquatic plants is reviewed for removal of heavy metals (Dhir, 2013; Förstner and Wittmann, 2012; Outridge and Noller, 1991; Rai, 2008), test in laboratory (Rane *et al.*, 2015; Singh *et al.*, 2006) and ground circumstances (Cardwell *et al.*, 2002; Meitei and Prasad, 2016). Some plants accumulate heavy metals and elements when its amounts exceeds nutritional requirement of plants by a process of phytoremediation to treat environment. Sometimes metals taken up by such plants are transported through roots and shoots and then expelled, this phenomenon is known as phytoextraction (Ebbs and Kochian, 1998; Raskin *et al.*, 1997). Plants in surrounding of industrial areas are important as they have ability of phytoremediation. However, it is not possible to reduce their ability to accumulate specific type of metal like lead or cadmium. Abundant literature about bio accumulators is available (Brown *et al.*, 1994; Dodangeh *et al.*, 2018; Ebbs and Kochian, 1998; Raskin *et al.*, 1997). It is not possible to specify a specie for phytoremediation, it depends on the ecological location of such plants. Surrounding areas can be protected by such plants (Porębska and Ostrowska, 1999; Siuta and Żukowska-Wieszczek, 1990).

Many countries are extensively working on wild plants chemical composition (Eromosele and Paschal, 2003). In some countries vegetables are very expensive, the wild plants can be best alternative. The local markets of Korea sell 112 wild plants at higher prices than cultivated plants. Chinese and Korean dishes are prepared by the weeds exported to USA (Pemberton and Lee, 1996). Several authors consider edible wild plants uses (Densmore, 2012; Facciola, 1990; Kunkel, 1984; Prance and Nesbitt, 2012). Varieties of expensive vegetables are grown in fields in Pakistan (Khattak *et al.*, 2006). They lack most vitamins that can be combated by using wild vegetables. We need to explore chemical composition of these plants if they are suitable as feed. Aim of this study was to determine mineral composition of selected wild plants.

Material and methods

Collection of Plants

Plants were collected from Mardan district. Deionized water was used for washing plants which were dried in sun. Further dehydration was done in oven. Hammer mill was used for crushing, crushed plant was kept in airtight polyethylene bags and refrigerated.

Atomic absorption Spectroscopy

Nitric acid and perchloric acid mixtures were used to prepare plant samples (Khattak *et al.*, 2006). Desiccators were used to cool the contents in vessel to room temperature. Nitric acid (6M) was put in crucibles in amount of 2.5 mL. The contents were dissolved by heating, then filtered. Perkin Elmer 400 model Flame atomic absorption spectrophotometer was used for analysis. Glassware was kept in nitric acid, and washed by deionized and distilled water to prevent contamination. Samples were tested for Co, Cd, Ca, Fe, Cu, Zn, K andmg contents by procedure of AOAC (2003). Test was repeated thrice.

Result and discussion

The current study was designed to examine the concentrations of various elements and heavy metals in four wetland plant species of family Polygonaceae i.e. *Rumex dentatus, Rumex hastatus, Polygonum aviculare* and *Persicaria glabra* collected from District Mardan, during 2016 and 2017. Elemental analyses of these species were carried out in the Central Resource Laboratory, University of Peshawar, Pakistan. The results revealed that Highest content of Cd and K found in *Rumex dentatus* i.e. 0.016mg/L and 63.41mg/L and lowest is in *Rumex hastatus* i.e; 0.002mg/L and 1.252mg/L, respectively. Highest quantity of Zn was found in *Rumex dentatus* i.e; .417 and lowest in *Rumex hastatus* i.e; 0.0268. The Fe content was below the level. The Cu quantity was maximum in *Rumex dentatus* which was 0.019mg/L and minimum in *Rumex hastatus* that was 0.004mg/L. The *Rumex hastatus* have highest value for Co i.e; 0.229. Lowest value of Co was observed in *Rumex dentatus* that was 0.035mg/L. The *Persicaria glabra* show lowest quantity for both Ca andmg, i.e; 4.310mg/L and 3.963mg/L respectively. While maximum quantity of both Ca andmg, i.e; 19.25mg/L and 4.529mg/L was found in *Rumex hastatus*. Results are presented in Table and Fig. 1, 2, 3 and 4. In the urban areas heavy metals contamination of freshwater ecosystems is continuously on the rise (Jha *et al.*, 2016). Many emergent rooted plants have capacity to Phyto-stabilize pollutants in the sediments through accumulation in roots which reduce the hazard to environment and its effects on health of human. Heavy metals accumulation capacity is found in both native and invasive plants in different parts of plant.

Table 1. Mineral composition of plants.

S. No	Plant Biological Names	Family	Cdmg/L	Znmg/L	Cumg/L	Comg/L	Kmg/L	Camg/L	Mgmg/L
1	*Persicaria glabra*	Polygonaceae	0.009	0.260	0.011	0.064	23.46	4.310	3.963
2	*Polygonum aviculare*	Polygonaceae	0.008	0.305	0.013	0.055	60.07	10.60	4.344
3	*Rumex dentatus*	Polygonaceae	0.016	0.417	0.019	0.035	63.41	18.16	4.485
4	*Rumex hastatus*	Polygonaceae	0.002	0.026	0.004	0.229	1.252	19.25	4.529

The plants have ability to store important minerals in all portions which are significant in human diet (Bilal *et al.*, 2010). For example Mn, Cr and Zn are known as hypoglycemic elements as they play important role in glucose metabolism. It has been reported that Mn, Cr and Zn are essential in maintaining insulin secretion. In some plants Co, Cd and certain other elements which do not have direct relation to physiology of plants are accumulated (Bello *et al.*, 2004). Very important role in treatment and prevention of various human diseases is played by Trace elements (Saeed *et al.*, 2010). Due to environmental reasons some toxic heavy metals are also accumulated in plants that create serious health hazards (Mireles *et al.*, 2004). Bilal *et al.* 2010 and Saeed *et al.* 2010 reported similar results of their findings. The Pb and Cd are toxic trace elements which are dispersed in environment most probably due to human activities causing pollution (Bello *et al.*, 2004; Mireles *et al.*, 2004).

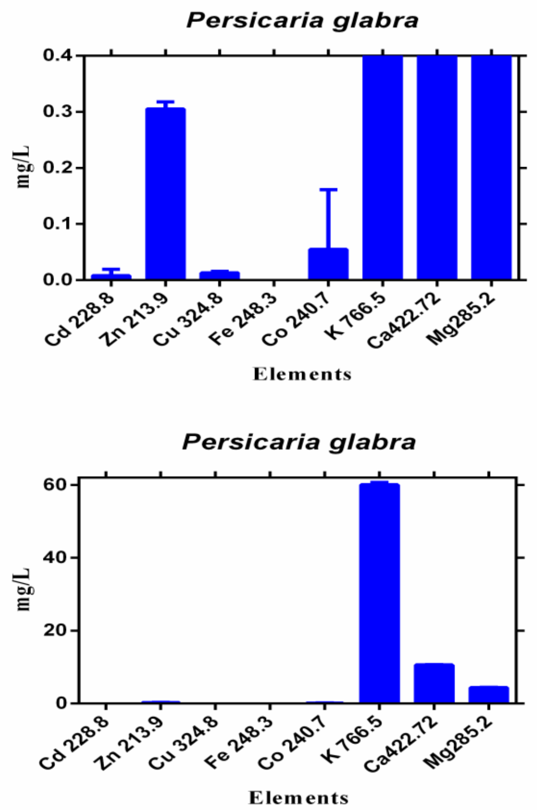

Fig. 1. Elemental composition of *Persicaria glabra*.

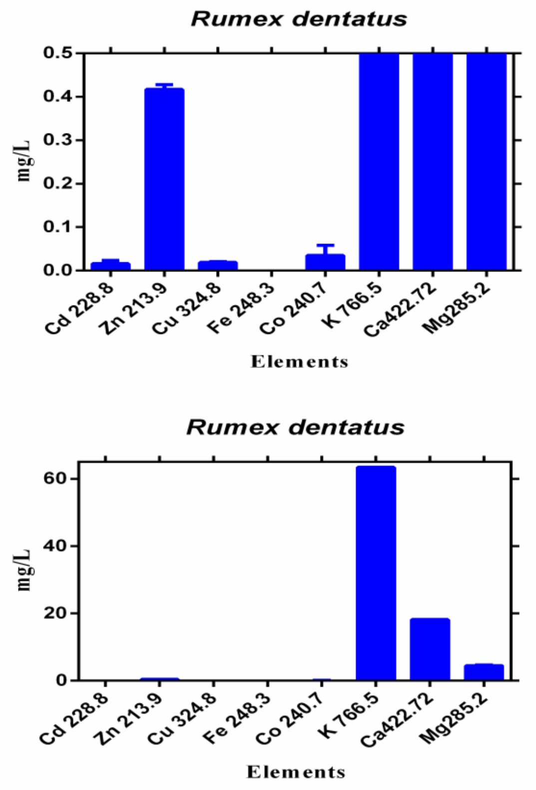

Fig. 3. Elemental composition of *Rumex dentatus*.

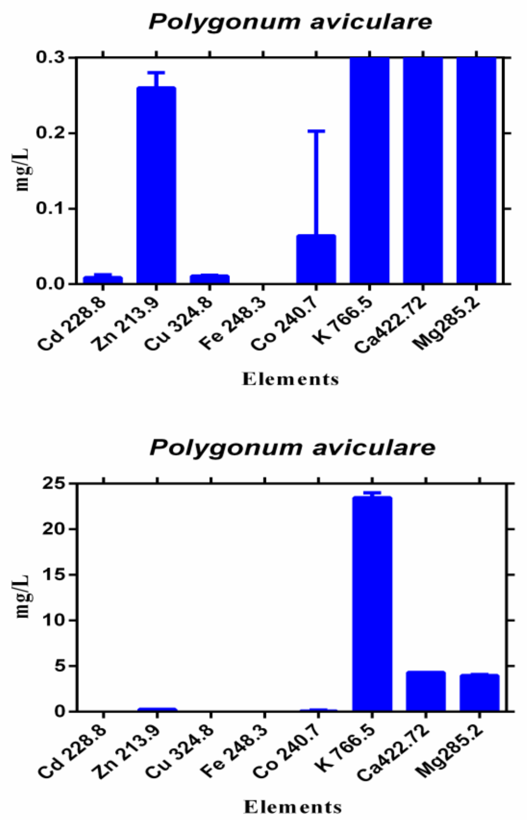

Fig. 2. Elemental composition of *Polygonum aviculare*.

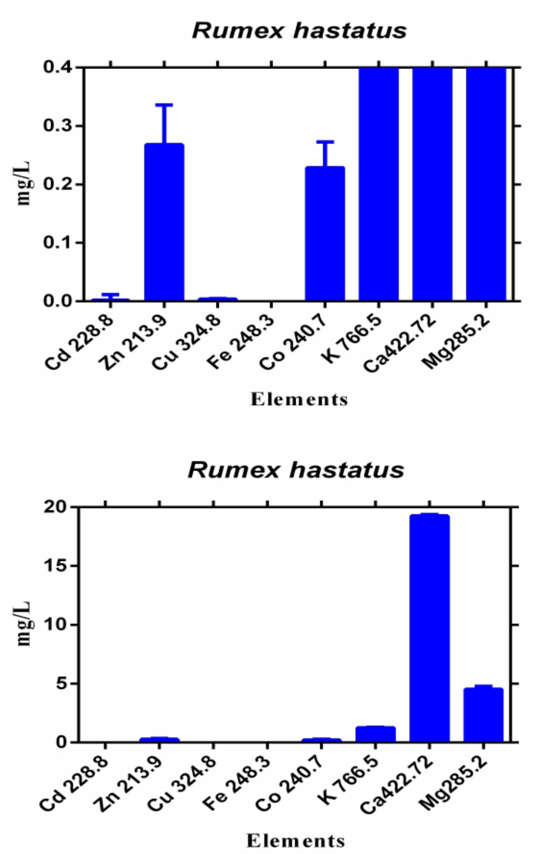

Fig. 4. Elemental composition of *Rumex hastatus*.

Conclusion

These wild plants are a good source of minerals as well as bio remediators. Wild plants should be evaluated with respect to human food and their nutritional composition. These plants have ethnobotanical importance i.e. *R. dentatus* and *R. hastatus* are mostly used as food while *P. aviculare* and *P. glabra* are important medicinal species.

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