Original Article

Estimation of trace and toxic metals from citrullus colosynthis Lin: A medicinal plant of district Kech, Balochistan, Pakistan

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Objective: To inhance the knowledge of rural population regarding good and bad effects of trace and toxic metal present in the said medicinal plant citrullus colosynthis Lin and validating the use of this plant as traditional drug in treating particular diseases.

Methodology: Roots, stem, leaves, flowers and seeds of the plant from district Kech, Balochistan was analyzed for metals including iron (Fe), copper (Cu), zinc (Zn), sodium (Na), potassium (K), magnesium (Mg), calcium (Ca), cadmium (Cd), lead (Pb), nickel (Ni) and cobalt (Co) using flame atomic absorption spectroscopy.

Result: The plant contained high concentration of Fe, Na, K, Mg and Ca, moderate concentration of Cu and Zn, a very small concentration of Pb, Ni and Co, while Cd was below the detection limit.

Conclusion: Due to significantly high concentration of Fe and Ca, it is suggestive to use the plant in management of anemia and arthritis. (Rawal Med J 2014;39: 270-273).

Key words: Trace and toxic metals, medicinal plants, Citrullus colosynthis.

INTRODUCTION

Wild Plants are popular source of treatment across the globe due to their availability and affordability. Balochistan is rich of diverse species of medicinally important plants due its varying climate. Plant under discussion is one of the folk drugs for remedies of several ailments by residents of Balochistan. Medicinal plants are being used as alternative drugs, in the rural areas the Pakistan because of availability, affordability and safety.[1] However, health practitioners are reluctant to prescribe these products because of deficiency of knowledge and concerns about the product safety, liability, and presence of pathogenic and chemical contaminants which may be deleterious to health.[2] While some plants contain essential elements in small doses which are both therapeutics and prophylactic in nature, some people may suffer from heavy metal poisoning.[3]

Citrullus colosynthis is called Gunj and Kulkushta in Balochi. The plant tastes bitter and pungent and seeds oil of the plant has laxative and anti-inflammatory effects. Other medicinal uses include treating elephantiasis, ulcer, bronchitis, urinary discharges, breast inflammations and ophthalmia.[4] The plant is vermifuge and also used to treat constipation, gum diseases, to dry up pimples, to keep hair from falling out, to relieve pain associated with rheumatism, to treat leucorrhea, as a sexual stimulant in men, to activate the menstrual cycle in women, and use to treat piles and inverted anus.[5] Fruit are good to treat bronchial asthma and strengthen eyesight and for wound healing, abdominal pain and hepatitis. Seeds are used to treat diabetes and root stick is useful to relieve toothache and earache.[6] Dried fruits powders are used for dropsy.[7] Pulps are used to treat various abdominal and urogenital diseases and fever.[8] Fruit and root are considered as antidote to snake poison[9] White spotted skin is also corrected by crushing the plant's fruit on bare foot.[10] The aim of this study was to determine trace and toxic metals present in citrullus colosynthis and validating the use of this plant as traditional drug in treating particular diseases.

METHODOLOGY

Roots, stem, leaves, flowers and seeds samples of plant were collected from district Kech of Balochistan, Pakistan. Samples were prepared by wet acid digestion method with little

modifications.[11] Stock solutions were prepared by making the volume of digests up to 25ml with 2N HNO_3 after filtration through whatman filter paper No.42 and analyzed by Atomic absorption spectrometer.

RESULTS

Table 1 shows iron (Fe), copper (Cu), zinc (Zn), sodium (Na) and potassium (K) content of various parts of plant.

Table 1. Concentration of metals in various parts of Citrullus colosynthis.

Plant Parts	Iron (mg/kg)	Copper (mg/kg)	Zinc (mg/kg)	Sodium (mg/kg)	Potassium (mg/kg)
Root	461.515± 2.624	10.929± 0.789	31.026± 1.175	455.509± 0.104	646.536± 0.416
Stem	434.242± 2.624	8.197± 0.789	31.538± 0.769	432.176± 0.180	495.103± 0.544
Leaves	53.939± 2.624	7.741± 0.789	53.007± 1.175	308.176± 0.200	413.493± 0.272
Flowers	1710.0± 2.624	6.831± 0.789	43.077± 1.404	298.176± 0.100	328.255± 0.566
Seeds	29.697± 2.624	5.464± 0.789	30.000± 0.769	93.843± 0.161	276.569± 0.416

Table 2. Concentration of metals in various parts of Citrullus colosynthis.

Plant parts	Magnesium (mg/kg)	Calcium (mg/kg)	Cadmium (mg/kg)	Lead (mg/kg)	Nickel (mg/kg)	Cobalt (mg/kg)
Root	1239.234± 4.785	2596.154± 19.230	ND	0.727± 0.014	0.820± 0.077	ND
Stem	856.459± 4.785	2948.718± 20.016	ND	0.734± 0.007	0.875± 0.075	0.184± 0.014
Leaves	1406.699± 4.785	1538.462± 9.615	ND	0.749± 0.015	0.954± 0.041	1.068± 0.015
Flowers	1732.057± 7.309	2403.846± 19.230	ND	0.762± 0.015	1.044± 0.036	0.369± 0.019
Seeds	2444.976± 4.785	1185.897± 14.687	ND	0.763± 0.007	0.828± 0.035	ND

ND = not detected.

Magnesium (Mg), calcium (Ca), cadmium (Cd), lead (Pb), nickel (Ni) and cobalt (Co) content is shown in Table 2.

DISCUSSION

Iron levels were observed higher in flowers than other parts of the plant. Hence, Citrullus colosynthis in general tonic may be advised to compensate for an iron deficiency in anemic patients due to its high iron content. Flowers of Citrullus colosynthis contained (1710mg/kg) of iron, which is highest among the other parts of the plant. This could be the reason of its use in treatment of anemia by rural population.

Copper is an essential element for normal growth and development of plants but can be toxic at an excessive level higher than (100mg/kg) dry weight.[12] Copper contents of Citrullus colosynthis roots were 10.929mg/kg, in stem were 8.197mg/kg, in leaves were 7.741mg/kg, in flowers were 6.831mg/kg and in seeds 5.464mg/kg. Higher concentration of Cu accumulated in roots may be due to fact that it is actively taken up by plant underground roots and is not readily transported to above ground vegetative parts.[13]

Zinc is essential for the growth and multiplication of cells, for skin integrity, bone metabolism and functioning of taste and eyesight.[14] Zinc deficiency causes diabetic hyposmia, hypogeusia and even weight loss.[15] Levels of zinc were higher (53.007mg/kg) in leaves followed by flowers (43.077mg/kg). Levels of Zinc; in all parts of the plant investigated was occurred in the range of (30-53.007mg/kg).

Sodium is important for transportation of metabolites across the cell. A low sodium level is characterized by mood changes, muscle cramps, fatigue, hair loss, hypotension and dehydration.[16] Higher sodium concentration was found in the roots (455.509mg/kg) followed by stem (432.176), leaves (308.176mg/kg) and flowers (298.176mg/kg). The recommended daily intake of Na is 13.8 mg/day.

Potassium performs a vital role in regulation of membrane potential, signal transduction, insulin secretion, and hormone release, regulation of vascular tone, cell volume and immune response. Higher concentration (646.536mg/kg) was recorded in roots, followed by stem (495.103mg/kg), leaves (413.493mg/kg) and flowers (328.255mg/kg). Average intake of Potassium is 2300 mg/day for adult women and 3100 mg/day for adult men.[13] These facts may support use of the plant in treatment of jaundice and kidney diseases.

Important functions related with Mg include contraction and relaxation of muscles, functioning

of certain enzymes in the body, production and transportation of energy and synthesis of protein. Early symptoms of Mg deficiency are anorexia, apathy, confusion, fatigue, insomnia, irritability, muscle twitching, poor memory and reduced ability to learn.[17] Lowest concentration of magnesium was noted in the stem and highest was noted in the seeds. Its deficiency may leads to diabetes mellitus because it is an important mineral for carbohydrate and fat metabolism.[18] This may explain its popularly in management of diabetes.

Calcium is essential for building strong teeth, bone and prevention from osteoporosis, sending and receiving nerve signals, contraction and relaxation of muscles, releasing of hormones, essential for keeping a normal heartbeat and important in blood clotting by activating the conversion of prothrombin to thrombin.[19] Calcium contents were maximum (2948.718mg/kg) in the stem. This could be the possible reason of the plant use in the treatment bone deformities such as rheumatism, and other painful inflammations of bones.

Cadmium is a nonessential trace element with no known direct functions both in plants and human, except it suspicious involvement in metabolic processes. Interestingly concentration of cadmium was below the detection limit in all samples. Lead in lowest concentration was observed in root and highest in the seeds. Inhalation, oral ingestion and cutaneous absorption are the major routs of lead into human; mainly deposited in bones.[19] The safe limit of lead for human consumption is 25µg/kg body weight.[20]

Lead cannot easily be taken up by plants from soil due to it poor mobility and molecularly sticky nature, but once it is taken by the plant can easily be transported upward into shoots, leaves and sometimes, the fruits.[21] Accumulation of higher concentration of lead in aerial parts may be due to air born lead also. Higher levels of lead in aerial parts suggested that Citrullus colosynthis is strong bio-accumulator of lead.

Flowers had the highest concentrations of nickel (1.044mg/kg) while roots had the lowest. Nickel is believed to affect hormones, cell membranes and enzymes. Nickel is required in a very minute quantity and shows its presence in pancreas taking part in insulin production and it deficiency in body result in liver malfunction. Cobalt is the important constituent of vitamin B-12. Cobalt has therapeutically been used to treat anemia.[22] Cobalt was below the detection limit in root and seeds samples, while stem, leaves and flowers of the plant contained a very low amount of cobalt.

CONCLUSION

Majority of metals were in roots than aerial parts whereas flowers and seeds had the lowest concentration of metals. But few metals were found in higher concentration in seeds and flowers than other parts. Accumulation of metals in higher concentration in aerial parts including seeds suggested that the plant is bio-accumulator of that metal. All parts of the plant contained metal in concentration within the permissible ranges prescribed by WHO and other international agencies. It is therefore, concluded that the use of this medicinal plant in treatment of various diseases is safe in the perspectives of metal contents and its uses in folk medical system is in accordance with the local knowledge.

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REFERENCES

1. Ahmed SS, Husain SZ. Ethnomedicinal survey of plants from salt range (Kallar Kahar) of Pakistan. Pak J Botany 2008;40:1005-1011.
2. Hussain J, Khan AL, Rehman N, Hamayun M, Shinwari ZK, Malik W, et al. Assessment of herbal products and their composite medicinal plants through proximate and micronutrients analysis. J Med Pl Res 2009;3:1072-7.
3. Brather P, Schramel P, editors. Trace elements analytical chemistry in medicine and biology: proceedings of the first international workshop Neuherberg, Federal Republic of Germany. Berlin:Walter de Gruyter;1980.p.678.
4. Ishaque M, Memon A, Noor M. Survey and domestication of wild medicinal plants distributed in Sind province of Pakistan. Final research report 1983-84

to 1987-88, published by department of plant breeding and genetics Sind University of Agriculture, Tandojam, Pakistan, 1988.
5. Goodman SM, Ghafoor A. The ethnobotany of Southern Balochistan, Pakistan: with Particular reference to medicinal plants. Field Museum of Natural History; 1992.
6. Rahman A, Choudhary MI, Bullo S. Monograph medicinal plants of Sindh indigenous knowledge and scientific facts. Sind. Department of Planning And Development; 2002.
7. Tareen RB, Tahira B, Khan MA, Ahmad M, Zafar M. Indigenous knowledge of folk medicine by the women of Kalat and Khuzdar regions of Balochistan, Pakistan. Pak J Bot 2010;42:1465-85.
8. Shah SR, Hassan G, Rehman A, Ahmed I. Ethnobotanical studies of the flora of District Musakhel and Barkhan in Balochistan, Pakistan. Pak J Weed Sci Res 2006;12:199-211.
9. Khan AM, Aslam M. Medicinal plants of Balochistan. Project on introduction of medicinal herbs and species as Crop. Pakistan. Ministry of Food, Agriculture and Livestock; Qarshi Industries (Pvt) Ltd; 2004. P. 3-44.
10. Qureshi R, Maqsood M, Arshad M, Chaudhry AK. Ethnomedicinal uses of plants by the people of Kadhi Areas of Khushab, Punjab, Pakistan. Pak J Bot 2001; 43:121-33.
11. Sahito SR, Kazi TG, Kazi GH, Shar GQ, Memon AN, Pirzado ZA. Comparison of Wet Ashing Method for medicinal plants, Celosia argentea and Cubeba officinalis by Atomic Absorption Spectrophotometer. J Chem Soc Pak 2004;26:135-9.
12. Diaconu D, Diaconu R, Navrotescu T. Estimation of heavy metals in medicinal plants and their infusion. Ovidius Univ Ann Chem 2012;23:115-20.
13. Fernandes JC, Henriques FS. Biochemical, physiological, and structural effects of excess copper in plants. Bot Rev 1991;57:246-73.
14. Thunus L, Lejeune R. Handbook on Metals in Clinical and Analytical Chemistry. Marcel Dekker, New York, 1994.
15. Rajurkar NS, Pardeshi BM. Analysis of some herbal plants from India used in the control of diabetes mellitus by NAA and AAS techniques. Appl Radiat Isot 1997; 48:1059-62.
16. Harper ME, Willis JS, Patrick J. Sodium and chloride in nutrition. In: Handbook of nutritionally essential minerals. (Eds.): B.L. O'Dell and R.A. Sunde. New York: Marcel Dekke;1997. pp. 93-116.
17. Food and Nutrition Board, Institute of Medicine. DRI Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride. Washington, DC: National Academy Press; 1997.
18. Haque MZ, Rauf MA, Jalil MA, Islam MB, Ahsan MA, et al. Studies on the Production of Musabbar from *Aloe Vera.* J Adv Scient Res 2012;3:51-4.
19. Klaassen CD. Casarett and Doull's Toxicology, 6th edn. McGrawHill: New York; 2001. Pp. 827834.
20. FAO/WHO. Evaluation of certain food additives and contaminants. WHO Technical Report Series No. 837. 1993.
21. Jagrati A, Ruchi S, Nilima B, Kalpana S. Determination of levels of uptake of few heavy metals to the leaves of Menthaarvensis. Internat J Res Chem Environ 2012; 2:63-7.
22. Imray P, Langley A. Health-based soil investigation levels. London: Commonwealth of Australia; 2001.p.18.