Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Scholars Research Library

Annals of Biological Research, 2011, 2 (6):575-579
(http://scholarsresearchlibrary.com/archive.html)

Annals of Biological Research
Scholars Research Library
ISSN 0976-1233
CODEN (USA): ABRNBW

Concentration of the heavy metals in *Aloe vera* L. (*Aloe barbadensis* Miller) Leaves collected from different geographical locations of India

Swapnil Rai[1]*, Dinesh Kr. Sharma[2], S. S. Arora[3], Manisha Sharma[2] and A. K. Chopra[4]

[1]Department of Environmental Sciences ITM, University- Gwalior (Madhya Pradesh)- India
[2]Departmet of Chemistry, Mangalayatan University, Beswan- Aligarh (Uttar Pradesh)- India
[3]Department of Chemistry, B. S. A. College Mathura (Uttar Pradesh)- India
[4]Gurukula Kangri University, Haridwar (Uttarakhand)- India

ABSTRACT

Plants absorb a number of elements from soil, some of which have no known biological function and some are known to be toxic at low concentrations. Aloe vera plant has been known for its different properties and benefits in the field of medicine, skin care and beauty products. Its natural composition is very useful in the field of cosmetology and treatment of various diseases. The aim of this study was to assess the accumulation of heavy metals (Na, K, Ca, Mg, P, Fe, Cu, Zn, Cd and Pb) in Aloe vera leaves grown in different geographical locations of India. Minerals are the essential elements require for the growth and development of the plants and living organisms. The concentration of Na, K, Ca, Mg, P, Fe, Cu, Zn, Cd and Pb were found quite high in all the samples. Results reveal that the composition of metals in Aloe vera is dependent on the chemical composition of soil and its direct use as cosmetic and for medicine is not good. The results also showed that Aloe vera plant can also be used as a good Phytoremediation agent as it absorbs heavy metals from the soil in high quantity.

INTRODUCTION

Aloe Vera has been on this earth for millennia and it is a member of the Liliaceae family. This plant is *Aloe vera* Linne, also known as *Aloe barbadensis* Miller, and *Aloe vulgaris* Lamarck (1**).** Aloe Vera has historical references dating back over 5000, where it can be seen on the tombs of the pharaohs. Apparently it was an herbal remedy used in embalming mummies, both as a superb preservative but also as an excellent preventive agent against tuberculosis and other respiratory complications innate to that kind of work. Fast forward a thousand years and the Europeans began using it as an important ingredient in their herbal based medicines. The earliest recorded pharmacological usage was recorded in ancient Sumeria about 1750 B.C. where it was considered as an excellent treatment for stomach irritations and nausea (2).

Most of Aloe species are indigenous to Africa, but now have wide distribution in the tropical and subtropical regions of the world. They are grown in warm climates, both as wild and cultivated plants, in countries in southern, eastern and northern Africa, countries bordering the Mediterranean and Red Seas, in India, in islands of the Indian Ocean, and in China. They also were grown in abundance in the islands of the Caribbean area - Aruba, Barbados, Bonaire, Jamaica, Puerto Rico - as well as in Florida, Texas, California, Arizona and Mexico on the North American continent (3**)**

Heavy metals are important environmental pollutants and many of them are toxic even at very low concentrations. Pollution of the biosphere with toxic metals has accelerated dramatically since the beginning of the industrial revolution (4). The primary sources of this pollution are the burning of fossil fuels, the mining and smelting of metalli ferrous ores, municipal wastes, fertilizers, pesticides, and sewage (5). Heavy metal accumulations in edible plants are commonly reported by scientist to alert the public on potential risks of toxicity effects (6). Plants absorb a number of elements from soil, some of which have no known biological function and some are known to be toxic at low concentrations. Heavy metals enter the biological cycle through the roots and leaves of plants and are enriched in various plant organs. They can directly affect plant growth and an excess dietary intake of contaminated plants could also be dangerous for the health of humans and animals. The chemical composition of plants reflects the elemental composition of the soil (7).

Minerals are nutritive elements which are present in tissues and fluids of all body. They maintain certain physio-chemical processes, structural components of tissues and as constituents of enzymes in many metabolic pathways (8, 9, 10).The chemical composition of any plant depends upon the local geographical condition, type of soil and its composition. Keeping the above in view the present study was designed to analyse the trace metal content of *Aloe vera* L. (*Aloe barbandensis* Miller) viz. Liliaceae leaves.

MATERIALS AND METHODS

The samples of *Aloe vera* leaves were collected and analysed using the method reported by various workers (11).

Collection of sample: Mature healthy and fresh leaves of *A. vera* were collected from the Nurseries and Botanical garden of different locations namely Site I (Aligarh), Site II (Agra), Site III (Mathura), Site IV (Bareilly), Site V (Haldwani) and Site VI (Haridwar) in India. Leaves were taken and washed with fresh water.

Sample Preparation: The leaves were cut in to small pieces and their thick epidermis was removed. The solid gel of the leaf was homogenised and dry ashing method was adopted by placing the properly dried and ground plant sample in to the vitresile crucible overnight in an electric muffle furnace maintaining the temperature between 410-440 °C. This ashing destroys all the organic material from the sample. The ash was removed from crucible and allowed to dry in desicator. The yield of ash was appoimately 5 gm/ 100 gm.

Analysis of Samples

1 gm of sample ash was taken and digested using conc. HNO_3, H_2SO_4 and $HClO_4$ in the ratio of 10:6:3 and dried at 240°C. The digested sample was made up to 50 ml volumetric flask and used for assay of trace elements by AAS (Atomic Absorption Spectrometer) using suitable hollow

cathode lamps of Perkin Elmer A Analyst 100. The phosphorus was analysed with colorimeter using ammonium Vanadate-molybdate method. Five replicates were prepared for the each sample.

RESULTS AND DISCUSSION

The study was conducted to determine the heavy metal accumulation in leaves of the Aloe vera plant. The results showed that the elements viz Na, K, Ca, Mg, P, Fe, Cu, Zn, Cd, and Pb were present in high concentrations in all the sites (Table 1). Comparative differences were found in the composition of all samples. The concentration of heavy metals is also depending on the physiographical conditions, developmental activity and type of waste generated from the area.
The importance of trace element in living organisms was first showed over a century ago. The existence of a number of trace metals containing enzymes was also demonstrated by Claunde Bernard and Mcmum (11). In present study concentration of different heavy metals found high which may be due to absorption from soil. These metals also play important role in different metabolic activities of body and also regulate them. Studies in humans and animals showed that optimal intake of trace elements like Cu, Zn, Na, Mg, Ca, Cr, and I can reduce individual risk factors. The role of inorganic elements like Cr, Zn, Fe, Cu, and Mn also improved the impaired glucose tolerance and their indirect role of management of diseases diabetes mellitus. Zn is a versatile element which has been well known to be an important trace element in diabetes as a cofactor for insulin. Zn also enhances the effectiveness of insulin (12). Potassium is necessary for the optimal insulin secretion (13). Studies in experimental animals have clearly shown that iron deficiency has several negative effects on important functions of body. Copper is also serve as constituents of many enzymes which contain copper in the active sites and catalyse the oxidation reactions. It plays a key role in the haemoglobin synthesis (14). Trace elements present in *Aloe vera* have a significant ant diabetic activity (15).

There is evidence of both Chinese and Egyptians using Aloe Vera to treat burns, wounds and to reduce fevers. American Indians called Aloe "The Wand of Heaven". They believed than anyone touched by Aloes' gel would be cured of their skin disorders. Also, the legend says that Cleopatra used Aloe Vera as part of her beauty regime. Although many still consider Aloe Vera to be a folk remedy, it is important to remember that two-thirds of the world's population is treated with herbs and plant products that are not only effective, but offer benefits that are equal or superior to the synthesized, chemically-derived remedies of the western world.

Present study also showed a high metal concentration in Aloe leaves. Similar results were also reported by many researchers in previous studies. It is also reported that some of the plant species can accumulate very high concentrations of toxic metals to levels which far exceed the soil levels (16). In many ways, living plants can be compared to solar driven pumps which can extract and concentrate several elements from their environment. From soil and water, all plants have the ability to accumulate heavy metals which are essential for their growth and development. These metals include Mg, Fe, Mn, Zn, Cu, Mo and Ni (17). Certain plants also have the ability to accumulate heavy metals which have no known biological function. These include Cd, Cr, Pb, Co, Ag, Se and Hg (18). However, excessive accumulation of these heavy metals can be toxic to most plants. The ability to both tolerate elevated levels of heavy metals and accumulate them in very high concentrations has evolved both independently and together in a number of different plant species (19). Memon and co-workers, while working with 62 plant species in 39 genera and 27 families from the natural forest of Central Japan, reported several

multi accumulator plant species concentrating several hundred fold levels of Mn, Cu, Zn, Cd, Co and Ni in their leaves (20, 21 ,22) compared to non-accumulator plants.

The presence of all the essential elements in *A. vera* may readily account for the most of the therapeutic efficiencies. The identified compounds play important role in the insulin secretion of the body. Although some harmful elements also absorbed but with suitable techniques it can be used for various diseases as a safe and useful drug. As it is also used as herbal drug *Aloe vera* will be useful in decidly the dosage of herbal drugs prepared from these variety for the management of diseases related to metabolic disorder after the removal of harmul toxic metals from the leaves with suitable techniques.

Table 1: Concentration±S.E. of trace elements (µg) in leaves of *Aloe vera*

Element	Site I (Aligarh)	Site II (Mathura)	Site III (Agra)	Site IV (Bareilly)	Site V (Haldwani)	Site VI (Haridwar)
Na	309±11	300±10	338±14	273±10	190±8	215±7
K	362±10	310±8	271±10	301±18	180±10	282±11
Ca	289±6	280±7	326±11	356±16	297±11	315±9
Mg	125±8	120±6	198±9	155±12	210±9	138±6
P	120±10	98±6	101±6	153±13	82±7	127±9
Fe	19.23±1.8	18±2	13±2	16±1	9.2±1.3	11±2
Cu	2.34±0.6	1.23±0.3	2.14±0.2	1.81±0.8	1.14±0.3	1.32±0.3
Zn	198±6	200±8	180±11	236±11	92±8	219±10
Cd	1.2±0.1	1.3±0,1	1.36±0.2	1.93±0.4	1.41±0.2	1.67±0.6
Pb	12±2	8±1	16±2	24±3	8±1	10±1

CONCLUSION

The results of the present study showed that *Aloe vera* plant is a good absorber of metals and concentration of minerals depends on the different geographical conditions as well as composition of soil. Therefore direct use of this plant for human may cause health problems but can be used after proper removal of metals by appropriate techniques. This study also concluded that it can also be used for the removal of heavy metal from the soil and waste water because it has the capacity to absorb the metals from soil.

REFERENCES

[1] Reynolds, G. W. **1974**. The aloes of South Africa, ed. 3. (Aloe SA)
[2] Huxley, A., ed. **1992**. The new Royal Horticultural Society dictionary of gardening. (Dict Gard)
[3] Wyk, B.-E. **2009**. Medicinal plants of South Africa. (Med Pl SA)
[4] Nriogo J O (**1979**). *Nature* 279: 409-411
[5] Kabata-Pendias A, Pendias H (**1989**). Trace Elements in the Soil and Plants. Florida: CRC Press.
[6] Fauziah, S.H.; Wan Siti NurHajar, W.I.; Agamuthu, P.; **2010** Heavy Metal Accumulation in Plants: A Case Study of Ipomoea reptans and Helianthus annuus. URL: http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=5517443

[7] Shehu A., Mullaj A, Harizaj F, Shehu J (**2010**). Assessment of Heavy Metals Accumulation by Different Spontaneous Plant Species Grown along Lana River, Albania. BALWOIS, Republic of Macedonia. 25-29.
[8] Malhotra VK **1998**. Biochemistry for Students.Tenth Edition. Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, India.
[9] Lozak, A., K. Soltyk. And P. Ostapczuk. **2002**. *Sci. Total Enviorn*, 289:33-40.
[10] Eruvbetine D **2003**. Canine Nutrition and Health. A paper presented at the seminar organised by Kensington Pharmaceuticals Nig.Ltd., Lagos on August 21, 2003
[11] Sharma DK, Rai S, Arora SS, Gupta PM, Sharma R. and Chopra AK (**2011**)**.** *Journal of Chemical and Pharmaceutical Research*: 3(3) 64-68.
[12] L Coulston; P. Dandona. *Dibetes*, **1980**, 29, 665-667.
[13] MK Underwood; MJ Rosentha; S Hong. Trace elements in human and animal nutrition, Academic, **1986**, New York.
[14] A Rajendran; V Narayananand; I Gnanavel. *Journal of Applied Science Research*, **2007,** 3(11), 1476-1478.
[15] SK Rajasekaran; K Sivagnanam; S. Subramanian. *Biological Trace Elements*, **2005**, 107, 1-11.
[16] Baker AJM, Brooks RR (**1989**). *Biorecovery* 1: 81-126.
[17] 17. Langille WM, MacLean KS (**1976**). *Plant Soil* 45: 17-26.
[18] 18. Hanna W J, Grant CL (**1962**). *Bull Torrey Bot Club* 89: 293-302.
[19] 19. Ernst WHO, Verkleji JAC, Schat H (**1992**). *Acta Bot Neerl* 41: 229-248.
[20] 20. Memon AR, Ito S, Yatazawa M (**1979**). *Soil Sci Plant Nutr* 25: 611-620.
[21] 21. Memon AR, Chino M, Takeoka Y, Hara K, Yatazawa M (**1980** a). *J Plant Nutr* 2: 457-477.
[22] 22. Memon AR, Ito S, Yatazawa M (**1980** b). *Soil Sci Plant Nutr* 26: 271-280.