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Analysis Of Non-Volatile Toxic Heavy Metals (Cd, Pb, Cu,Cr And Zn) In ALLIUM SATIVUM (Garlic) And Soil Samples ,Collected From Different Locations Of Punjab, Pakistan By Atomic Absorption Spectroscopy

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Abstract. Garlic is one of the most widely used medicinal plants. The monitoring of toxic metals such as lead, Cadmium, Chromium, Copper and Zinc in garlic and the soil of garlic fields collected from ten different cities of Punjab is critical for preventing public health against the hazards of metal toxicity. The levels of toxic heavy metals in garlic and soil samples were investigated using Atomic absorption spectrometer. The metal content in garlic samples was found to be in increasing order as Cr> Pb> Cd> Cu> Zn. Infield metal content in the soil also followed the same trend. In garlic samples, Pb, Cd, Cr, Zn and Cu ranged from 0.039mg/L to 0.757mg/L, N.D to 1.211mg/L, 0.03mg/L to 0.451mg/L, 0.02mg/Lto0.42mg/L and 0.451mg/L to 0.893mg/L respectively. In soil samples, Pb, Cd, Cr, Zn and Cu were ranged from 0.459mg/L to 0.797mg/L, 0.205mg/L to1.062mg/L, 0.074mg/L to 2.598mg/L, 0.124mg/L to 0.276mg/L and 0.494mg/L to 0.921mg/L respectively. In our study, the Pb and Cd was found more in garlic from Gujranwala and Jaranwala, Cu and Zn were more in samples from Kasur while Cr was predominant in sample from Sheikhupura. Heavy metal content in soil and garlic samples was within the permissible limits proposed by World Health Organization (WHO).

Key words: Heavy metal toxicity, Allium Sativum, soil samples, AAS

Introduction

Research has shown that certain heavy metals are nutritionally essential for a healthy life in very small quantities such as (Fe, Cu, Mn, and Zn).Heavy metals become toxic , when they are not metabolized by the body and gather in the soft tissues. Heavy metals ranks high amongst the chief contaminants of leafy vegetables and medicinal plants [Ajasa, M.A, 2004] because heavy metals are non-biodegradable so they cause serious health hazards in humans and animals. The main source of metal accumulation in humans is the plants and vegetables consumed by them, grown in polluted areas. The presence of trace elements in plants fluctuate and depends mostly on various factors, such as soil PH and organic matter content [Logan, T.J, 1997]. Metal deposition in environment is either due to natural processes or a result of human activities. Factors responsible for soil contamination are extensive use of chemical fertilizers and pesticides, mining processes, industrialization, vehicular exhausts and several others. Chronic exposure to Lead results in birth defects, mental retardation and potential toxic effects on fetus. Elevated levels of cadmium and chromium are responsible for lung, renal and cardiovascular diseases. Long term exposure to copper cause kidney damage, brain damage and even death. Zinc is an essential element and an integral component of many coenzymes, essential for DNA and RNA synthesis but toxic in higher concentrations. Herbal products are being extensively used in Asian (especially in Pakistan and India), several African and Western Countries in the complementary and alternative system of medicine [Patwardhan B, 2005] Garlic is an important ingredient of almost every meal and is widely used in Pakistan because of its antioxidant, antimicrobial, and antifungal activity. It is used either as a spice or remedy for various disorders. It is effective for high blood pressure patients, reduces bad cholesterol, and prevents cancer and heart attack. So the main objective of this study was to determine the levels of toxic heavy metals in garlic samples and their comparative distribution in different regions of Punjab, Pakistan.

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Materials and Methods

Sampling

Ten Garlic and soil samples were collected from ten different locations of Punjab. The plants were identified and the voucher specimens were deposited in the herbarium of the department of botany for the reference. Underground rhizome of garlic was used for analysis. Soil samples were taken from the fields selected for garlic collection.

Preparation of Soil Samples:

For collection of soil samples, the whole field was divided into four equal sectors and samples were taken from four different locations of each sector, combined and mixed to form a single sample. Soil samples were collected from two layers, upper layer (05-10cm) and lower layer (20-40 cm).These samples were dried and analyzed for heavy metals.

Preparation of Garlic Samples

Garlic rhizomes collected from different locations were rinsed with tap water followed by Milli-Q water and dried at 70°C for 2 days. After drying they were ground into fine powder and sieved through 0.5mm sieve, in air tight containers until analysis.

Analytical Strategy for Soil and Garlic Samples

Acid digestion of samples was carried out. About 0.2g of each sample was weighed in 25ml conical flask. Samples were digested overnight with 5ml conc. H_2SO_4. Heated at 128°C until the evolutions of brown fumes ceased. 2ml H_2O_2 was added in the sample and heated at 125°C for one hour with the evolution of intense white fumes. Again 2ml H_2O_2 was added, made upto the mark with 2% HNO_3. AAS was carried out on a Perkin Elmer Model analyst 800 with Hollow cathode lamp.

Preparation of Working Standards

Standard solutions **o**f all the metals were prepared by diluting AAS standard solutions (1000 ppm) of Pb, Cd, Cu, Cr and Zn. 0.1ml of each standard solution was taken in 100ml flask and made upto the mark with 2% HNO_3.

Data Validation

The accuracy of the method was evaluated by the percentage recovery of heavy metals at different spiking levels into the soil and garlic samples before carrying out the digestion. The % recoveries of Pb, Cd, Cu, Cr and Zn were in the range of 90% - 98.54%. Repeatability of the analysis was expressed in terms of SD and % RSD. Limit of detection (LOD) of instrument for Pb, Cd, Cu, Cr and Zn was, 0.01mg/L, 0.001 mg/L, 0.002 mg/L, 0.003 mg/L and 0.002 mg/L respectively.

Results and Discussion

All the garlic and soil samples were run in triplicate. The levels of metals detected in garlic and soil samples were compared with the maximum permissible limits of these metals in herbal medicines as established by WHO. All the metals were within the maximum permissible limits (MPL) The MPL for some selected metals such as lead, cadmium, copper and zinc as 10ppm, 0.3ppm, 20ppm and 50ppm, respectively. For chromium MPL is not specified [Geneva WHO. 1998]. The concentration level of heavy metals has been shown in Figure 1 and figure 2.

As compared to the other samples Pb and Cd was found to be present in high concentration in the garlic sample taken from Gujranwala, Cu and Zn was higher in sample from Kasur while Cr was higher in garlic taken from Sheikhupura city. Analysis of garlic and soil samples showed that soil samples contained relatively higher levels of these toxic heavy metals so that soil plays an important role in accumulation of metal content present in plants. The poisoning allied with the occurrence of toxic metals in medicinal plants has been reported previous in Asia, Europe and the United states S. Gupta et al,2010] so continuous monitoring is required to ensure the lower levels of toxic metals in medicinal plants and vegetables. Levels of these metals exceed in plants when they are grown in contaminated soil. Contamination results from the use of sewage water in agriculture, smelting and mining processes, use of chemical based fertilizers and rapid industrialization etc; Very low concentrations of heavy metals are essential for healthy life. Exceeding concentration are dangerous as their elevated levels interfere with the proper functioning of the body. So monitoring of heavy metals in herbal plants and medicines is required to avoid their toxic effects.

Conclusion

Most of the world population utilizes medicinal plants in more than one way but quality monitoring of plants is still in the prelude stage. The study has illustrated that some soil and garlic samples contained elevated levels of heavy metals, although they were within the safe limits. Soil heavy metal contents were higher as compared to garlic samples.This is the first report to access the toxic heavy metal in the garlic and soil samples, collected from different locations of Punjab. This study will not only focus on the role of regulatory and monitoring authorities in safety measures of raw material but will also guide the farmers in elevating the plant –kind and place of cultivation.

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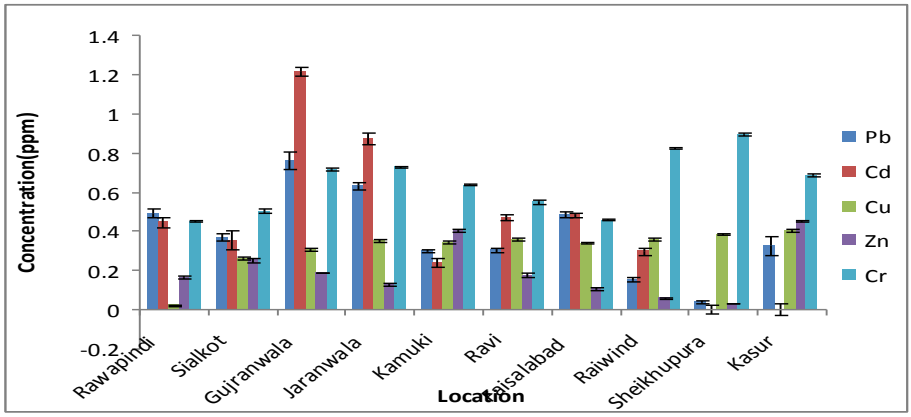

Fig.1 Conentration of heavy metals in soil samples collected from different locations

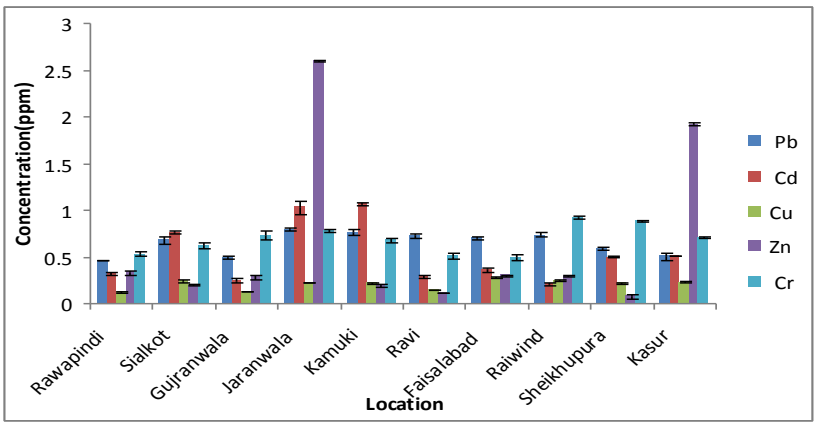

Fig. 2 Concentration of heavy metals in garlic samples collected from different locations