Estimation of Heavy Metals in the Roadside Plants (A Case Study of Lahore City, Pakistan)

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Abstract:

Toxic heavy metals are global problems which are growing threat to the environment. Roadways and automobiles are now considered to be one of the largest sources of heavy metals pollution. In the present study, plants' samples of *Ficus religiosa, Ficus beghalensis and Bambusa arundinacea* were collected from three different busy roads of Lahore, Pakistan i.e Mall road, Ferozpur road, BRB and Jinnah Garden sited. Concentration of various heavy metals i.e. Ni (II), Pb (II), Cd (II), Fe (II) and Cr (III) in the leaves of sample plants were analyzed by atomic absorption spectroscopy for estimation of metal pollution in the city. Comparison was made between different samples. Results showed that concentration of heavy metals varied from plant to plant and area to area. In all the plants, concentration of Cu ranged from 1.38 to 0.26 mg/L whereas the concentration of Fe ranged from 2.29 to 0.92mg/L. Concentration of Ni, Cd, Cr and Co varied a little and ranged from 0.54 to 0.02, 0.15 to 0.02, 0.54 to 0.08 and 0.23 to 0.01 mg/L. The level of heavy metal contents differed in the same plant collected from different roads. The results showed that the contents of different heavy metals in plants increased with the density of automobiles along the roads whereas, the plants along garden sites were least effected by heavy metals pollution.

Keywords: Atomic Absorption Spectroscopy, Toxic/ Heavy metals, Heavy metals pollution, roadside plants of Lahore.

Introduction:

The utilization of heavy vehicles and population outgrowths has profoundly increased the level of air pollution. One of components of air pollution is heavy metals. The presence of heavy metals in the environment is of major concern because of their toxicity, bio- accumulating capacity and threat to human life and the environment. Heavy metals are among the conservative pollutants that are

not subject to bacterial attack or other break down or gradation. As a result of this, their concentrations often exceed the permissible levels normally found in soil, water ways and sediments. Hence they can profoundly disrupt biological process (Battarbee etal., 1988).

Higher plants have appealed as indicator in air pollution monitoring in highly polluted areas where lichens and mosses are often absent. Higher plants act as bio monitors in the assessment of aerial heavy metal contamination by means of their bio accumulative properties. Therefore, mainly analytical approaches are used in monitoring of metals. Metal aerosols pollute soil and plants. Higher plants not only intercept pollutant from atmospheric deposition but also accumulate aerial metals from the soil by plants via their root system and translocate to other regions of the plants (Wissman). Particle deposition on leaf surfaces may effected by a variety of factors including particle size of mass, wind velocity, leaf orientation, size, moisture level and surface characteristics
(Bache et al. ,1991)

Pollution caused by traffic activities is increasingly becoming a great threat to urban environmental quality and human health in many municipalities in Lahore city. The main aim of this study is to estimate the accumulation of heavy metals in the roadside plants which can be used to clean up the heavy metal polluted environments and the relations between the concentration of heavy metals in polluted environments and their accumulation in higher plants. For this purpose, concentration of Ni, Pb, Cd, Cu, Fe, Co and Cr in the leaves of plants samples was measured. Common roadside plant i.e. *Ficus religiosa, Ficus benghalensis and Bambusa arundinacea* were used as bio indicators. Analysis of washed leaves samples provides elemental concentration in leaf tissue. The high concentration of heavy metals in the environment is reflected by high concentration of heavy metals in the plants and consequently in animals and human bodies. The ability of plants to absorb and accumulate heavy metals makes them useful as bio indicator of heavy metal pollution.

Methodology:

Experiment:

For the present study, plants sample were collected from three roadside areas of Lahore city i.e. Mall road, Ferozpur road and BRB. These roads are one of the most intensive traffic roads with daily traffic volumes ranging from 25000 to 20000, 15000 to 20000 and 5000 to 10000 vehicles respectively in 5 min. Moreover, the plant samples were also collected from Jinnah garden in order to compare the accumulation of heavy metals in road side and garden site plants.

Reagents and Apparatus:

6M HNO_3 and 6M HCl (1:2) were used for extraction of heavy metals from the plant samples. Instrumental analysis was followed by using flame atomic absorption spectrophotometer (FAAS). (Polarized Zeeman Hitachi 2000 was used).

Collection and post-harvest treatment of plant samples:

The plant species that were selected are *Ficus religiosa*, *Ficus benghalensis and Bambusa arundinacea* which are commonly grown along the road ways. The same plants were collected from the four selected sites and their leaves were further analyzed by Atomic absorption spectroscopy for the estimation of heavy metal pollution. The plant leaves were washed in fresh running water to eliminate dust, dirt and possible parasites and then treated with deionized water and dried in shade at 25°C – 30°C. During this sample processing, necessary measures were taken in order to avoid any loss or contamination of heavy metals.

Acid digestion of plants samples:

Weighted quantities of crushed and powdered samples of each plant leaves taken in china dish were heated in oven at 110°C to remove moisture. After drying, the contents of china dish were dissolved in 21ml mixture of 6M HNO3 and 6M HCl (1:2) taken in 250 ml round bottom flask in order to dissolve the contents. The samples were kept for one day and then filtered. The solution was transferred to a 50ml flask and diluted up to the mark.

Calibration of equipment:

For the elements under investigation, we develop the following sensitivity and detection limits respectively of the used FAAS apparatus: Pb 0.2 and 1.0ppm, Cr 0.5 and 3.0 ppm, Cd 0.2 and 1.0 ppm, Fe 0.5 and 5.0 ppm, Cu 0.5 and 3.0 ppm, Co 1.0 and 5.0 ppm and Ni 0.5 and 4.0 ppm.

Results and discussion:

Traffic pollution has resulted in significant accumulation of heavy metals in the roadside plant leaves but the pattern and level of accumulation varied remarkably between elements in all the plants. Concentration of Cu ranged from 1.38 to 0.26mg/L whereas concentration of Fe ranged from2.29 to 0.92mg/L. Concentration of Ni, Cd, Cr and Co Varied a little and ranged from 0.54 to 0.02, 0.54 to 0.08 and 0.23 to 0.01mg/L. The concentration of Ni, Pb, Cd, Cu, Fe, Co and Cr in plant samples taken from different sites in summarized in the **list 1.** The differences found among elements in the levels of accumulation suggested that the relative importance of the individual elements contributing to urban environmental deterioration varied considerably.

High concentration of heavy metals in environment is a matter of great concern to public safety all over the world but this problem is more serious in Pakistan due to usage of old automobiles and low quality gasoline. Results showed that concentration of heavy metals varied from plant to plant and area to area.

List 1: Concentration of heavy metals in plant samples Taken from different sites;

Pb

The concentration of Pb was found to be highest among all the heavy metals estimated which ranged from 25.53 to 12.19 mg/L. Major Sources of Pb are in old paints, lead solder in cans, lead in soils from previous gasoline exhaust, lead emissions from incinerators, and lead in food chain. Lead is leading cause of birth defects cardiovascular disease, hypertension, neurological disease, kidney disease, learning disability, retardation, tooth cavities (Blumer and Reich, 1980).

Fe

The concentration of Fe ranged from 2.29 to 0.92mg/L. Fe is an essential element for human and animals and also an essential component of hemoglobin. The high concentration of Fe in plants is due to foliar absorption from the environment auto body rust and engine parts. The dietary limit of Fe in the food is 10-60mg/day (Kaplan et al., 1993). Low Fe contents causes gastrointestinal infections, nose bleeding and myocardial infarction (Hunt, 1994).

Cd

The concentration of Cd ranged from 0.15 to 0.02 mg/L that may result from tire wear fuel burning and batteries. Cadmium has been found to be a promoter of sperm abnormalities, birth defects, uterine fibroids, infertility, spontaneous abortions, lung and brain cancer, and peripheral neuropathy (Kjellstrom et al., 1979).

Cu

The concentration of Cu ranged from 1.38 to 0.26 mg/L. Cu enters the environment through bearing wear, engine parts and brake emissions. Copper exposure over log period can damage the brain, kidneys and cornea (P. Isacson et al., 1985).

Ni

The higher level of nickel, the cancer rate (Independent policy research center organized by State governors, Nov 1991). Chronic low level exposure can cause serious lung damage, birth defects and kidneys disease and lungs cancer (Thatcher et al., 1982). In present study, concentration of Ni ranged from 0.54 to 0.02 mg/L.

Cr

Sources of Cr are the air conditioning coolants, engine parts and break emissions. The concentration of Cr ranged from 0.54 to 0.08 mg/L.

Co

The concentration of Co was very low that ranged from 0.23 to 0.01 mg/L.

The toxic metals have been documented to be reproductive and developmental toxins, causing birth defects and damaging fetal development, as well as neurological effects, developmental delays, learning disabilities, and behavioral abnormalities in many otherwise normal appearing children .

Conclusion:

Our study proves that the plants selected by us accumulate heavy metals in their leaves. Thus, they can be recommended as bio indicators for the determination of pollutant levels of the environment.

Among all the plant species selected, *Ficus religiosa* showed the maximum accumulation of heavy metals. Thus this plant can be grown along the busy roadsides in order to reduce the heavy metal pollution.

The results also showed that the concentration of heavy metals increases with the density of automobiles along the roads indicating that traffic and automobiles are the major source of heavy metal pollution.

The contents of heavy metals were least in the plant samples collected from garden site showing that these plants are least effected by heavy metal pollution.

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References:

A Beasley, "High levels of copper in water also a danger", Orlando Sentinel, 11-24-92.

Battarbee R.W., Anderson N.J., Appleby P.G., Flower R.J., Fritz S.C., Haworth E.Y., Higgitt S., Jones V.G., Kreiser A., Munro M.A.R., Natkanski J., Oldfied F., Patrick S.T., Richardson N.G., Rippy B. and Stevenson A.C, 1988. Lake Acidification in the United Kingdom: 1800-1986, ENSIS Publishing, London**.**

Blumer and Reich, 1980. Environment International vol. 3.

Electric Utilities and Long-Range Transport of mercury and other Toxic Air Pollutants, Center for Clean Air Policy (Independent policy research center organized by State governors), Nov 1991.

Kjellstrom T, Friberg L, Rahnster D. 1979. Mortality and cancer morbidity among cadium exposed workers 28:199-204 [Midline].

P. Isacson et al, ‘‘Drinking water and Cancer Incidence in lowa", American Journal of Epidemiology, 1985; 121:856-859.

Thatcher RW, Lester ML, Mcalaster R, Horst R. 1982. Effects of low levels of cadmium and lead on cognitive functioning in children. Arch Environ Health 37(3):159-66.

Viaence MK, Roels HA, Leenders J, De Groof M, Swerts Lj, Lison D, Masschelein Neurotoxicology 20(1):7-16.

Wissman M. N. Columbia Univ., Science News, 12-595, p391.