Lead Concentration in Road Side Dust and Selected Vegetables of Lahore City, Pakistan

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Abstract. The contents of lead as a pollutant in road side dust and vegetable samples of urban and rural areas of Lahore city, Pakistan, were monitored with the help of atomic absorption spectrophotometer. Average concentration of lead in dust samples collected from residential areas was 25 to 165 mg/L, from rural areas 9.5 to 13.0 mg/kg, from commercial areas 201 to 1685 mg/kg, and from canal side 105 to 220 mg/kg. In most of the vegetable samples, lead level was in the permissible range, whereas in some samples, the average lead concentration ranged from 0.13 to 5.0 mg/L.

Keywords: lead, vegetables, soil

Introduction

Lead is distributed widely in nature in different forms because of its easy working qualities and permanence. It is used in batteries, cable sheaths, solder, radiation shielding etc. The widespread uses of lead in manufacturing of tetraethyl antiknock agents and paint pigments such as white lead, red lead and chrome yellow etc. led to environmental and health problems. It is difficult to know the natural lead level in the presence of human activities. In natural conditions lead is estimated to be 0.01 mg/kg in food, 0.0005 mg/kg in water, and 0.15 mg/m³ in air (Maharachpong *et al*., 2006; De, 1996). Lead levels in air vary with location and weather. In water, lead is derived from soil and rocks, fallout, dust and vehicular exhausts. Lead is widely distributed in food, with the widest variation in root and green vegetables. This variation reflects the contamination of soil by domestic and industrial fallout. Lead in vegetables and fruits cannot be removed by washing (Beg *et al*., 1987). In soil and dust, it is recognized as a public health problem and permissible lead levels in the soil have been proposed (Rodriguez-Flores and Rodriguez-Castellon, 1982). Lead is cumulative body poison (Wahlin *et al*., 2006). There are three means, by which lead enter our body system through air, water and food and produce toxic symptoms. The toxicity of lead has been studied extensively in recent years at trace and sub trace levels, by many countries on continuous basis to keep a check on their

natural food supply before use (Wei and Yang, 2010). Mild level lead poisoning causes anemia, headache, fatigue and irritation. Acute lead poisoning in humans leads to severe damage of kidney, liver, brain, central nervous system, reproductive organs and sometimes to death. However, toxicity of lead compounds depends on their solubility in body fluids. The smaller is the particle size, the greater is its solubility and hence the toxicity. All these facts cause great concern for public health, demanding accurate determination of this metal ion at different sites, in different vegetables and items of human use so as to be able to avoid potential human health risk (Shi *et al*., 2011).

Techniques principally used for the determination of trace concentrations of lead are atomic absorption spectroscopy, colorimetry, polarography and emission spectroscopy and inductively coupled plasma. In this presentation lead is determined in roadside dust and vegetable samples by atomic absorption spectrophotometry as it is essentially a trace analysis technique and is one of the most powerful tools in chemical analysis, due to it rapidness, high sensitivity, specificity and being relatively free from interferences (Khairy *et al*., 2011).

Materials and Methods

Sampling. Forty samples of road side dust were collected along the intersection of major roads, residential, commercial and rural areas. Samples were also collected from pavements, side gutters and sidewalks, where traffic density was high or low. Twenty three samples

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of various vegetables were collected from different rural and urban areas of Lahore city including high ways, motor way and bund road (Brown, 1986).

Sample digestion. Soil/dust samples were collected and pulverized to pass through a 100 mesh sieve and dried at 105 to 110 °C to constant weight. Sample (2-5 g) was mixed with 10 mL of concentrated nitric acid in a beaker then heated gently. Again 10 mL of concentrated nitric acid and 10 mL of 70% perchloric acid were added and the mixture was boiled until the solution became almost colourless. The mixture was heated to reduce the volume down to 2-3 mL then cooled. 10 mL of water was added and warmed to dissolve the salts. Samples were filtered, volume was made 100 mL using distilled water and the so prepared solution was used for analysis.

All vegetable samples were oven dried at 130- 150 °C, grinded and 2 g of each sample in 250 mL beaker was treated with 5 mL of nitric acid. The beaker was covered with watch glass and heated on hot plate. After 1 h, the contents of beaker were treated with further 5 mL of nitric acid and 1-2 mL of 35% hydrogen peroxide was added while swirling the contents. The heating was continued until the volume of the sample was reduced down to 2-3 mL. It was then cooled, filtered using Whatman filter paper # 42 and volume was made 100 mL with double distilled water in a 100 mL volumetric flask. A blank was prepared using the same procedure (Brown, 1986). The samples were analyzed by atomic absorption spectra 40 Varian Australia (Lu *et al.*, 2009). Calibration graph was prepared using stock solutions of lead.

Results and Discussion

The samples were analyzed using atomic absorption spectra and calibration graph was prepared using stock solution of lead which was linear passing through the origin (Fig. 1), in the range of 0.1 to 10 mg/kg of lead (Paoletti *et al.*, 1991). WHO limit of lead in soil as a reference value is 13 mg/kg (Faiz *et al.*, 2009). Comparison of various areas shows average concentration of lead to increase from 25 ± 0.17 to 165 ± 0.20 mg/kg in the residential areas, far away from the freeways (Table 1). In the rural areas, lead was the lowest (Fig. 2) ranging from 9.5 ± 0.20 to 13 ± 0.12 mg/kg within the WHO limits (Table 2); the reason is the low

traffic density corresponding to the distance of the rural areas from the main city (Wahlin *et al.*, 2006). Maximum concentration of lead was found in the commercial areas of Lahore ranging from 201 ± 0.41 to 1685 ± 0.94 mg/kg (Table 3). Commercial areas of Lahore are mostly surrounded by multi-storey buildings which act as sink
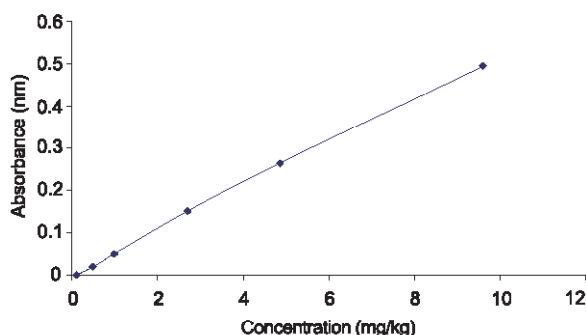

Fig. 1. Pb(II) calibration curve.

Table 1. Lead concentration in dust samples of residential areas of Lahore

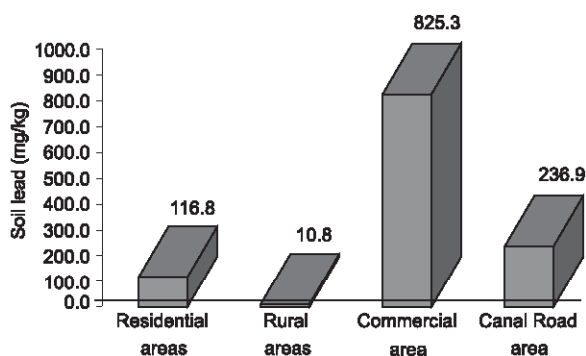| Sample no.	Pb concentration (mg/kg)	Sampling areas
S-1	50.0 ± 0.26	Muslim Town, Ferozepur Road
S-2	129.0 ± 0.24	Qaudri Cowk Township
S-3	75.0 ± 0.16	Johar Town
S-4	25.0 ± 0.17	College Road, Township
S-5	156.0 ± 0.21	Garden Town
S-6	$< 1 \pm 0.02$	Blank
S-7	135.0 ± 0.17	Model Town
S-8	165.0 ± 0.20	Johar Town, Main Road
S-9	156.0 ± 0.17	Misri Chowk
S-10	115.0 ± 0.17	Main Defence Road
S-11	120.0 ± 0.26	Defence Road Hospital
S-12	130.0 ± 0.26	Defence Road School

Fig. 2. Average Pb concentration in different areas of Lahore.

Table 2. Lead concentration in dust samples of rural areas of Lahore

S. no.	Pb concentration (mg/kg)	Sampling area
S-1	10.0 ± 0.20	Rice field, near Rohi Nallah
S-2	13.0 ± 0.25	Wheat field, village Kamahan
S-3	9.5 ± 0.20	Rice field, village Harpalkey
S-4	11.0 ± 0.26	Wheat field, village Leel
S-5	< 1 ± 0.02	Blank
S-6	13.0 ± 0.12	Corn field, badian
S-7	9.5 ± 0.17	Defence Bhatta Chowk
S-8	9.7 ± 0.09	Sugar cane from State Life Agricultural land

Table 3. Lead concentration in dust samples of commercial area of Lahore

S. no.	Pb concentration (mg/kg)	Sampling area
S-1	850.0 ± 1.24	Ichhra School Ferozepur Road
S-2	895.0 ± 0.81	Ichhra Bus stop
S-3	870.0 ± 0.81	Garden Town Bus stop
S-4	790.0 ± 0.82	Model Town Bus stop
S-5	710.0 ± 0.82	Ittifaq Hospital
S-6	201.0 ± 0.41	PCSIR Bus stop
S-7	670.0 ± 0.47	Waltan Road R.A Bazar
S-8	795.0 ± 0.94	Sadar Road
S-9	< 1 ± 0.02	Blank
S-10	806.0 ± 0.47	Dharampura Main Road
S-11	816.0 ± 0.41	Railway Station
S-12	1685. ± 0.94	Ravi Road

of pollutants. The increase in lead pollution may be due to the large traffic volume, emitting substantial quantity of lead along with smoke and other unwanted gases. It is concluded that soil along the roads having heavy traffic load contains more lead as compared to that of other areas.

The concentration of lead along the Lahore canal ranged from 105 ± 0.82 to 220 ± 0.82 mg/kg (Table 4). This may be due to the location of the site, being relatively open with wide roads, covered on both the sides by large trees and vegetation. Although deposition of lead depends on traffic density, but it may be influenced by many factors such as wind velocity and direction, precipitation and humidity (Faiz *et al.*, 1996). It was

Table 4. Lead concentration in dust samples of Canal Road area

S. no.	Pb concentration (mg/kg)	Sampling area
S-1	210.0 ± 0.82	Fatah Garh
S-2	220.0 ± 0.82	Mughalpura
S-3	130.0 ± 0.94	Dharampura
S-4	195.0 ± 0.82	Herbanspura
S-5	114.0 ± 0.94	Taj Pura
S-6	150.0 ± 1.24	Lal Pul
S-7	200.0 ± 0.82	Punjab University
S-8	143.0 ± 0.82	Shah the Khoi
S-9	201.0 ± 1.25	Jallo Road
S-10	< 1 ± 0.02	Blank sample
S-11	105.0 ± 0.82	Jallo Park
S-12	142.0 ± 0.82	Mall Road

Table 5. Lead concentration in vegetable samples collected from rural and urban areas of Lahore

S. no.	Vegetables	Pb concentration (mg/kg)
1.	Onion (U)	0.32 ± 0.02
2.	Spanich (U)	4.2 ± 0.12
3.	Mint (U)	0.3 ± 0.03
4.	Mustard (U)	5.0 ± 0.21
5.	Potato (U)	0.56 ± 0.12
6.	Radish (U)	0.13 ± 0.02
7.	Turnip (U)	0.35 ± 0.02
8.	Cauli flower (U)	1.3 ± 0.16
9.	Carrot (U)	0.52 ± 0.04
10.	Pea (U)	--
11.	Lettuce (U)	--
12.	Coriander (U)	2.99 ± 0.07
13.	Maize (U)	0.20 ± 0.03
14.	Wheat (R)*	0.15 ± 0.03
15.	Rice (R)*	0.13 ± 0.02
16.	Ginger (U)	0.20 ± 0.03
17.	Brinjal (U)	0.50 ± 0.04
18.	Cucumber (U)	0.30 ± 0.04
19.	Tomato (U)	0.25 ± 0.02
20.	Lady finger (U)	0.20 ± 0.03
21.	Cabbage (PU)	0.15 ± 0.02

U = urban area; R = rural area; all samples were taken along the Lahore Motor Way to Kalashah Kaku and Defence rural area to Badian Road, High Way and Bund Road; * = wheat and rice samples were collected from the rural areas, whereas all the rest of vegetables, from the urban areas.

observed that the average concentration of lead in vegetables ranged from 0.13 ± 0.02 to 5.0 ± 0.21 mg/kg (Table 5) and in some vegetables, lead was below the detection limit. The accumulation of lead in green vegetables may be due to the use of polluted water for irrigation, use of lead arsenate as insecticide/fungicide or due to the fertilizer impurities or atmospheric pollution. However, lead concentration was higher in leafy vegetables as compared to the root tubers and vegetables (Duong and Lee, 2011; Farmer, 1993).

Faiz *et al.* (2009) conducted a study on road pollution with respect to heavy metals in Islamabad Pakistan, in which average lead concentration was shown as 29 ± 104 mg/kg while in the present study, samples from the residential areas (Table 1) have lower concen- tration of lead (minimum 25 ± 0.17 to maximum 165 ± 0.20 mg/kg). The minimum and maximum lead concentrations in the rural areas (Table 2) were 9.5 ± 0.20 mg/kg and 13 ± 0.12 mg/kg, respectively, while there were very high concentrations of lead in commercial areas of Lahore (Table 3) as compared to the residential and rural areas; these results are also much higher than the results of Faiz *et al.* (2009) reported in his study. The results of commercial areas in our study are much higher conforming to the reports of Faiz *et al.* (2009). The reason for higher concentration of lead in Lahore is the heavy transport load and dense population of the city (Faiz *et al.*, 2009; Han *et al.*, 2008).

Conclusion

It is concluded from the data presented here that high level of lead is present in the road side dust and leafy vegetables of Lahore. Lead is directly/indirectly entering and continuously polluting the environment. The hazards of lead pollution especially in growing children require particular attention, because children absorb and retain about 50% of the ingested lead as compared to 8% absorbed and retained by adults.

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