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Environmental Risk Assessment in Baghdad City by Determination of Lead Level in Soil Samples

Hussian Hassan Kharnoob

University of Tikrit - College of Pharmacy

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ABSTRACT

The concentration of lead has been determined in different sites of Baghdad during summer season 2008.Analysis was carried out using flame atomic absorption spectrophotometer technique (FAAST) at wavelength 217 nm and air-acetylene flame. The lead level was found in a particulate fraction in some soils of AL-Karkh is more than in AL-Rusafsa sites of Baghdad. The levels approach the hazardous limits in most sites as a result of industrial activities and exhaust cars which are very crowded in Baghdad streets.

Introduction

Baghdad, with its about six million inhabitants, the biggest and the most industrialized city in Iraq. Due to its development and increasing traffic volume eseptically about two millions used cars that enter Iraq from EU countries since March 2003. it is expected to suffer more from lead contamination; on other hand Iraqi gasoline still has tetraethyl lead as anti knocking agent, as well as the presence of a big car batteries factory (north east Baghdad) which uses old technique and it has no emission control devices at all. There is hardly any information regarding the dispersal and distribution of lead in different parts of the city. Lead is one of the non essential trace elements. It is useful but toxic lead is one of the commonest and most widely distributed of environmental metal poisons [1,2]. The natural and anthropogenic sources such as mining, Major Components smelting and leaded gasoline generate lead in soil [3]. Pb is more dangerous to children than adults because of babies and children's growing bodies absorb more lead, children's brain and nervous system are more sensitive to damaging effects of lead[4].

* Corresponding author at: University of Tikrit - College of Pharmacy, Iraq.E-mail address:

There is a relation between increasing exposure to lead and elevation in lead blood levels [5]. In china as an example of rapid developing country, children living in industrial area and in area with heavy traffic had high lead levels in their blood [6]. Sediments play major role in lead transformation within food web ; ingested sediment may be a major vector in the uptake and concentration of hazardous amount of lead in organisms use sediments as source of their food[7]. The toxicity of lead is very complex. Inorganic lead, Pb+2 is a general metabolic poison and cumulative in human.The inorganic lead compounds exist in environment [8] are listed in Table (1).

PbBrCl
α-2 $PbBrCl.NH_4Cl$
Minor Components
β-2 $PbBrCl.NH_4Cl$
$PbBrCl.2NH_4Cl$
$3Pb(PO_4)_2$. PbBrCl
$PbSO_4$
$PbO.PbBrCl.H_2O$

Table(1) Inorganic lead in Environment Lead bromochloride (PbBrCl) arises from reaction of lead oxide, formed by combustion of the tetraalkyllead additives, with halogenated scavengers that are added to the fuel, represent the major compound in vehicle exhausts [9].

$Pb(C_2H_2)_4+O_2+$halogenated scavengers $\longrightarrow$

$CO_2+H_2O+PbCl_2+PbClBr$

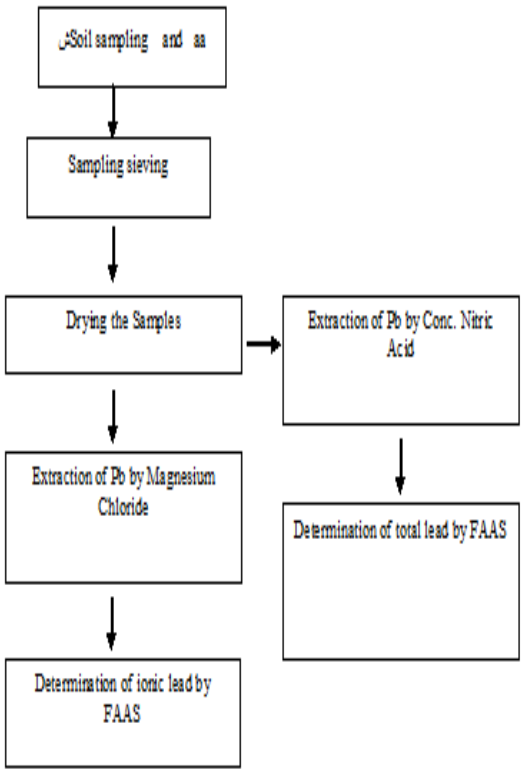
Lead inhibits enzyme system necessary for the formation of hemoglobin through strong interaction with –SH group[10].Lead (II) can replace Ca^{+2} in bones so tending to accumulate over long periods (lead alkyls such as tetraethyl lead are even more poisonous than Pb^{+2} species which is readily adsorbed from respiratory tract , gastrointesinal tract and skin where as the insoluble stable lead sulphate , sulphide and chromate are poorly adsorbed from gastrointestinal tract[11]. The absorbed lead is carried by red blood cells through body. It binds to bone, lungs , kidneys , brain and spleen [12].Tablel(2) represents the relationship between dose effect for adverse health effect of lead exposure [13].

Table(2) Dose-Effect Relationship for Adverse Health Effects of Lead Exposure.

Pb in blood(µg/L)	Health Effects
120	Rising severity death
100	Rising severity death
80	Severe CNS effect
60	Overt anemia
40	Nerve Conduction velocity
20	Hemoglobin Deficiency
10	Vitamin D Deficiency

Experimental and Results

The experimental design in this research was proceed as in the following scheme:



The locations for this research lie in Baghdad city (Figure -1). Baghdad is the capital of Iraq with Population density about 1160 person per Km^2 situated on the Tigris River at 33.23 N latitude and 44.23 E longitudes.

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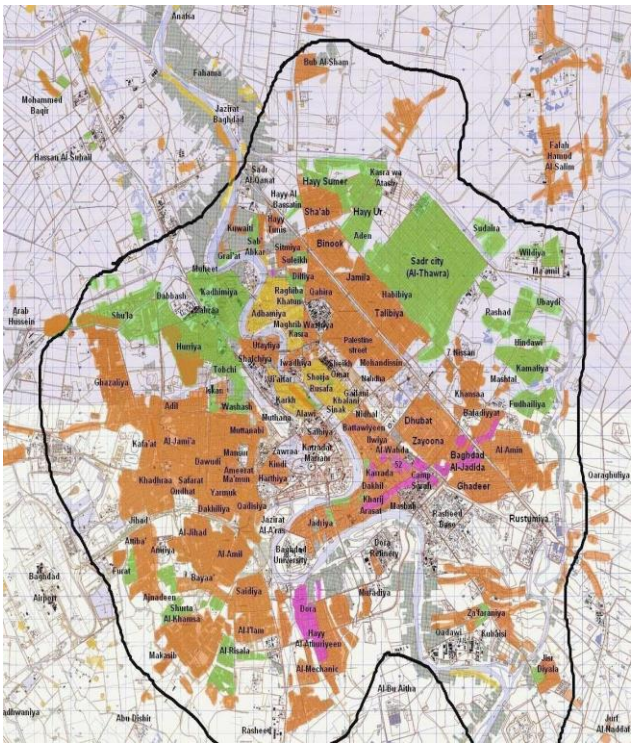


Figure (1) Location of Samples

Sampling

Fifty surface soil samples from Baghdad soil were collected during summer season 2008 .More attention was paid to the Pb distribution around car batteries factory surface soil (0-5) cm were collected and drying was done at room temperature over night. Twenty five samples were collected from each site of Baghdad at 12/4/2008, five samples from each location

Sieving and Extraction

The samples were brought to complete disaggregating by passing through a 2 mm sieve, using a stainless steel tool to separate the large soil particles. The duplicated sample (1 gm) was digested with 10 ml concentrated nitric acid and heated to reduce the volume to 2 ml then filtered through 541 filter paper. The volume was diluted to 25 ml with distilled water and the analysis was done by Varian flame atomic absorption spectrophotometer at the central laboratory in the ministry of environment in Baghdad . The wave length was 217 nm and flame of air – acetylene mixture for the total lead was used. The results obtained are listed in Table (3). Ion exchangeable lead was extracted from the sample by shaking (1g) of the sample with 10 ml of (1M) magnesium chloride for 1 hour, filter and complete the filtrate to 25 ml with distilled water. The analysis was done as for total lead using calibration standard curve method. The results obtained are shown in Table (4).

Table (3) Concentration of lead in Al-karkh sites (µg/g)

Site	Total lead	Ionic Lead
Al-jihad	90500	10150
Al-lliwia	41000	2025
Al-Biaia	29200	620
Al-Yarmook	7300	50
Al-Dora	116	9

Table (4) Concentration of Lead in Al-Rasafa Sites (µg/g)

Site	Total lead	Ionic Lead
Al-Waziria	42000	1750
Bab-Almoathim	4000	30
Bab-Alsharji	1115	25
Al-Nahtha	320	20
Al-Shaikh Omer	65	10

Discussion

The results in Table (3) which is described in Figure-2- indicate that the soils are highly contaminated with lead, but total concentration of lead is not good indication for environmental pollution [14], therefore the pollution is depending upon the concentration of ionic formula of lead than on its total concentration in soil samples.

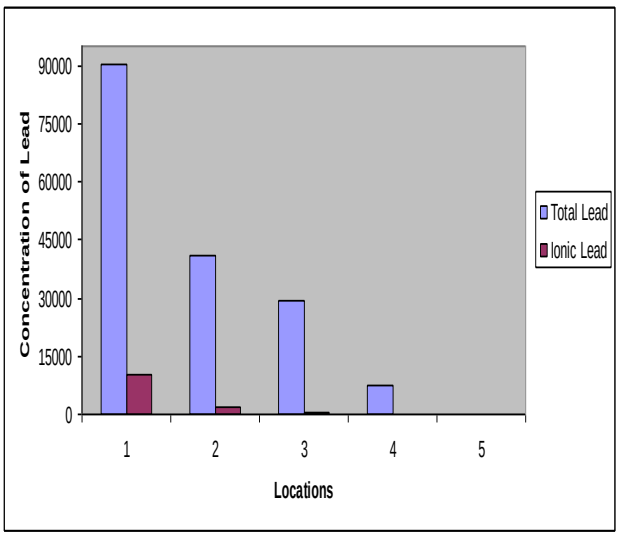
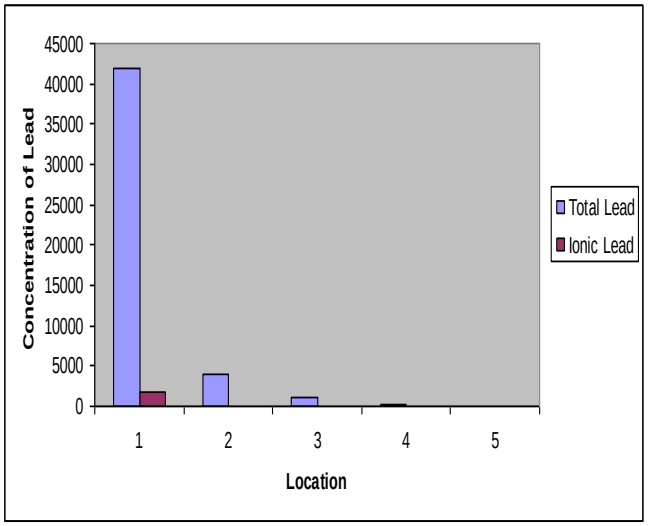


Figure (3) Total Concentration and ionic formula of lead in Al-Karkh Site

The pollution in the different soil sites of Al-Karkh is in order of Al-Jihad > Al-Biaia > Al-Alliwia > Al-Yarmook > Al-Dora .The results in Table (4) show that the soils in Al-Rasafa sites are less contaminated with lead than in Al-Karkh sites in the following order :-

Al-Waziria > Bab-Almoathim > Bab-Alsharji > Al-Nahtha > Al-Shaikh Omer. Figure (4) describes the total concentration of lead in Rasafa soil sites.



Figure(4) Total Concentration and Ionic Formula of lead in Al-Rasafa Site

The ionic exchangeable of lead is available to biota to be absorbed [15] ,adsorbed [16],ingested[1] and inhaled[18] by human , therefore ionic lead is more health effects than total lead[19] . The accuracy and precision of analytical method used in this work are shown in Table (5). They indicate that the method is reliable, sensitive and highly recovered.

Table(5) Accuracy and Precision of the Analytical Method

Concentration added (µg/ml)	Concentration found (µg/ml)	Recovery (%)	R.S.D. (%)
50	48.7	97.4	0.6618
50	48.5	97.0	0.5883
50	49.5	99.0	0.687

R.S.D = Relative Standard Deviation

Conclusion

Overall the sites used in this research are considered to represent moderate risk to the health of population according to the results obtained by many workers[20]. The concentration of ionic lead in soil which is hazard to children(20-25)µg/g, while the concentration of total lead (320-3925) µg/g , the previous numbers indicate that lead is more effective on children than on adults . The hemoglobin (Hb) expected for children living in contaminated soil should be low due to interfering of lead with an essential enzyme aminoevulinic acid dehydrates which is important in the biosynthesis of heme [21]

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