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TRACE METAL LEVEL OF HUMAN BLOOD FROM DARETA VILLAGE, ANKA, NIGERIA

***E. E. OGABIELA, E.M. OKONKWO, A. S AGBAJI, U.U. UDIBA, C. HAMMUEL, A. F. ADE-AJAYI AND B. NWOBI**

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ABSTRACT

The trace metal levels of blood obtained from some people in Dareta Village (a mining community) were determined. About 33 males of various age groups ranging from 1 to 40yrs were recruited for the study. The trace metals studied include Zn, Pb, Cd and Cu. These metals were analyzed using graphite furnace Atomic Absorption spectrophotometer(Shimazu AA-6800). The mean trace metal concentrations and their ranges were Zn, 8.42(5.21-14.44) mg/l; Pb 1.13 (0.25-2.65) mg/l; Cd 0.052(0.01-0.098) mg/l and Cu, 0.67 (0.154-2.178) mg/l. The levels of these metals were higher than acceptable limits, except for copper which is within safe limits. These metals could bioaccumulate and thereby pose a long term effect on man. These effects have been extensively discussed.

KEY WORDS: Human blood, Trace metals,Mining community, Bioaccumulation, Males

INTRODUCTION

Toxic metals are natural components of the environment, but human activities in mining, industry and agriculture, have been responsible for the wider diffusion of these elements. The almost ubiquitous presence of some metal pollutants facilitates their entry into the food chain and thus increases the possibility of them having toxic effects on humans and animals.Increasing pollution has given rise to concern on the intake of harmful metals in humans. These metals enter the human body through inhalation and ingestion. The intake through ingestion depends on food habit.

Trace amounts of heavy metals occur naturally in soil.However, exploitation of land for mineral extraction, manufacturingindustry and waste disposal has resulted in the inputand accumulationof large quantities of heavy metals.Unregulated inputs of metal contaminated materials into the natural environmentpose a range of both short- and long-term environmentalrisks. These heavy metals may find their way into the human body through food, water, air or absorption throughthe skin (Shibko, 1972; Goyer, 1996). Some of these metals bioaccumulate (Nriagu, 1979; Luckey*et al*, 1975; Babalola*et al*, 2007). Heavy metals which have received the most attention both in terms of sources and effects are those which are considered either (or both) as essential or toxic or show a high geochemical abundance, these include;zinc, iron, copper, molybdenum, lead, mecury and cadmium (Martin and Coughtrey 1982, Hawkes, 1997, Anetor*et al*, 2002).

Zinc is distributed widely throughout the body, and is deposited relatively slowly in the skeleton, where it is bound for long periods. Approximately 98% of the zinc in normal human plasma is protein bound. The principal carrier protein is albumin which binds about 80-85% of plasma zinc; approximately 15% is bound to 2-acroglobulin, less than 2% to retinol-binding protein and less than 1-2% of Zinc is free or ultrafiltrable (Giroux and Henkin 1972; Chivers, 1984; Foote and Delves 1984). Zinc is found in high concentrations in the choroid plexus, prostate, kidney, liver, lung, spleen, and brain (particularly the cerebellum and hippocampus) and may have long term effect (Durdana*et al*, 2007).

Exposure to lead occurs from breathing air, drinking water, and eating foods that contain Lead. Inhalation of Lead fumes or of fine Lead particles is the most important route of absorption in the working environment and general atmosphere. Chronic low-dose Lead exposure exerts subtle neuropsychiatric, reproductive and renal effects and children are particularly susceptible.

Death from Lead poisoning has occurred in children at blood Lead levels of 1.25 mg/L or higher.Lead poisoning in childhood is a chronic disease and currently it is accepted that even very low blood levels of Lead may induce developmental deficits (Gilman *et al;* 1990, Garrettson1990).

The Lowest Observe Adverse Effect Level (LOAEL) of Lead for children (causing developmental toxicity) is 0.1mg/L in blood. This level is associated with diminishing IQ score in children (Sax and Lewis 1989; ATSDR 1990).Acceptable daily intake (ADI) and other guideline levels provide maximum tolerable weekly intake of Lead: adults, 3 mg per person or 50 µg/kg body weight; children 25 µg/kg body weight(FAO/WHO, 1987). Lead interferes with the haem biosynthetic pathway, producing haematological effects, and competes at the molecular level with calcium. The central nervous system and kidneys are particularly sensitive to lead. The central and peripheral nervous systems are affected; gastrointestinal structures are also damaged; and there is strong evidence of effects on the reproductive system. Lead also may have a role as a cofactor in carcinogenesis (Goyer 1990; ATSDR 1990;

E. E. Ogabiela, National Research Institute for Chemical Technology, P.M.B 1052, Zaria, Nigeria
E.M. Okonkwo, National Research Institute for Chemical Technology, P.M.B 1052, Zaria, Nigeria
A. S Agbaji, National Research Institute for Chemical Technology, P.M.B 1052, Zaria, Nigeria
U.U. Udiba, National Research Institute for Chemical Technology, P.M.B 1052, Zaria, Nigeria
C. Hammuel, National Research Institute for Chemical Technology, P.M.B 1052, Zaria, Nigeria
A. F. Ade-Ajayi, National Research Institute for Chemical Technology, P.M.B 1052, Zaria, Nigeria
B. Nwobi, National Research Institute for Chemical Technology, P.M.B 1052, Zaria, Nigeria

Putnam1986; Sax and Lewis 1989).Lead is a cumulative poison and the acute symptoms are commonly a manifestation of chronic poisoning. Chronic symptomatic poisoning (plumbism) causes abdominal colicky pains, anorexia, nausea, vomiting, metallic taste, blue line on the gum margins, anaemia, peripheral neuropathy (wrist drop), convulsions and encephalopathy. In childhood, lead poisoning may be asymptomatic. There may be elevated levels of lead in the blood but symptoms are delayed. The so-called developmental syndrome, with cognitive and behavioral changes, is the consequence of the absorption of lead, mainly from pica. Anaemia is often a common manifestation (Prerovskaand Pickova1974; Gilman *et al,*1990; Garrettson1990).

Cadmium is classified as a toxic element; it is the byproduct of mining and smelting of zinc and lead. This element becomes toxic as a result of its accumulation over a period of time. The known geochemical implication of Cd in human health relate to bone and renal diseases in population exposed to contaminated water, plants and mining activity (Yasmin*et al*, 2010).

Zamfara State of Nigeria has a lot of untapped mineral resources. The natives tap these mineral crudely with so many mining sites scattered all over the state. Dareta Village is one of such mining community with so many mining mills in operation within the village. Recently (Wepedia, 2010), many deaths were recorded in Dareta and Bukkuyum villages in Zamfara State. These deaths were attributed to lead poisoning which informed this present study. The aim of this study is to determine trace metals level of human blood of people from Dareta Village to ascertain the level of bioaccumulation of these metals in the human body and proffer solution.

MATERIALS AND METHOD

For the investigation, 33 clients (all males) were recruited for the study. Their ages ranged from 1-40 years. About 5ml of venous blood were collected from each of the subject using disposable pyrogen free needle and syringe (Beckton-Dickinson, Dublin, Ireland). The blood samples were transferred into heparinized tube containing lithium heparin (Vacutainer system Inc., Rutherford, New-Jersey) and kept frozen at -20 ^{0}C until analyzed. The frozen blood sample were retrieved and allowed to thaw. One milliliter of the blood was pipetted (using micropipette) into clean test tube. To this, 5ml of conc. nitric acid and 5ml of perchloric acid were added and left on the bench overnight to digest the blood samples (Babalola*et al.*, 2007). The solution was later made up to 25ml with distilled deionized water and analyzed for trace metals using Shimadzu Atomic Absorption Spectrophotometer model AA-6800. Standard solutions of each of the metals were aspirated to calibrate the AAS before the aspiration of the sample.

RESULTS AND DISCUSSION

The average concentration of zinc, lead, cadmium and copper of human blood analyzed from the 33 respondents (all males) from Dareta village is presented in Table 1.

Zinc values in human serum of 1.09 to 1.3 mg/l was reported(Vallee, 1963), similar to those of iron; whole blood zinc, 8.8 ± 2.0 mg/l; and red cell zinc, 14.40 ± 2.70 mg/L. The normal or therapeutic value in blood is 0.68 to 1.36 mg/l and, in the CSF, 20 to 60 µg/kg/litre. From Fig I, the mean Zn concentration in blood is 8.986mg/l; this value is far above the normal therapeutic value in blood. Those in the age range between 11 to 20years had the highest Zn concentration of 10.103mg/l, while those in the age range between1-10 had the lowest concentration of 7.90mg/l. The high zinc concentration in the age range between 11 to 20 years may be attributed to active involvement of the age group in the mining processes without wearing necessary protective gears.

From Fig II, the average lead level in blood is 1.321mg/l. The highest average concentration of 1.72mg/l was found in theage range 31-40, while the lowest average concentration of0.94mg/lwas found in the age range 0-10. Most of the adult in this study work in the mine field and may have been exposed to lead dust. The children could have been exposed to lead from the dust that rises from the crushing mills scattered all over Dareta village and from playing with contaminated sand.

Cadmium is extremely poisonous and toxic to humans. In recent timeswhole blood cadmium concentration is the best measure of exposure. Whole blood levelsabove 10µg/l indicate significant exposure. Several studies (Roels*et al.*, 1981; Roels*et al.,* 1983) have revealed that in cadmium-exposed populations renal dysfunction is present when the concentration of urinary cadmium exceeds 10µg cadmium/g creatinine. From this study (Fig III), average cadmium blood concentration is 0.0495mg/l, with the adults (31- 40 yrs) having average concentration of 0.072mg/L and the children (1- 10 yrs) having concentration of 0.05mg/l which is still higher than the significant exposure concentration of 10µg/l. These high cadmium levels also may be attributed to the engagements of adults at the mine fields without necessary protective gears. Cigarette smoking is another important source of cadmium exposure(Majid*et al*1999). Dust from the grinding mills and intake through food may be responsible for the high levels of cadmium in children.Cadmium poisoning can result in lung damage, reduction of sperm count, kidney damage etc (Ibeto and okoye, 2009).

Copper is an essential trace element. In humans,it's essential for the proper functioning of organs and metabolic processes. However, acute or chronic exposure to copper results in copper induced toxicity. Liver is the target organ of copper induced toxicity. Other target organs include bone and the central nervous system. The allowable limit of copper for blood is between0.75-1.5mg/l (Yasmin*et al*, 2010). In Table I, the mean concentration of copper was found to be 0.750mg/L which is within the WHO allowable limit.From Fig IV, the highest average concentration of 0.984mg/l was observed in the range 31-40 years of age and the lowest average concentration of 0.572mg/l was observed in the age range 1-10 years.

Table I: Average Trace Metal Concentration(in mg/l) of Human blood of people from Dareta Village

Age (Yrs)	Pb± SD	Cd ± SD	Zn ± SD	Cu ± SD
A (1-10)	0.94± .53	0.05±0.03	7.90±2.35	0.572±0.36
B (11-20)	1.12±0.144	0.04±0.04	10.10±0.81	0.721±0.31
C (21-30)	1.50±0.07	0.04±0.04	8.52±3.69	0.724±0.77
D (31-40)	1.72±0.48	0.07±0.02	9.42±2.93	0.984±0.63
Mean	1.32±0.56	0.05±0.03	8.99±2.46	0.750±0.44

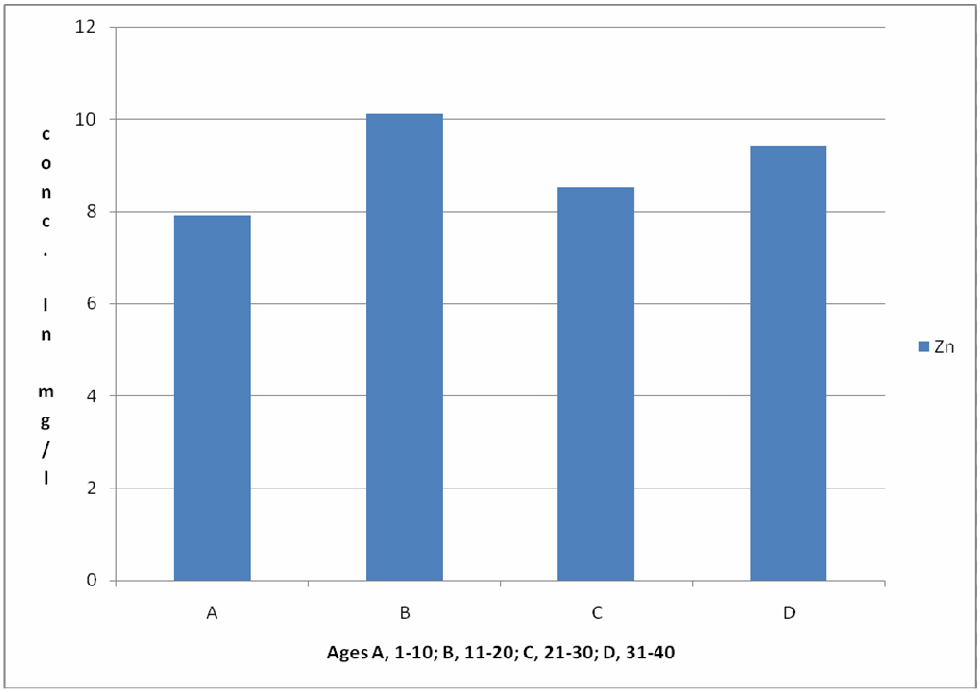

Fig I:**Concentration of zinc in human blood from Dareta village**

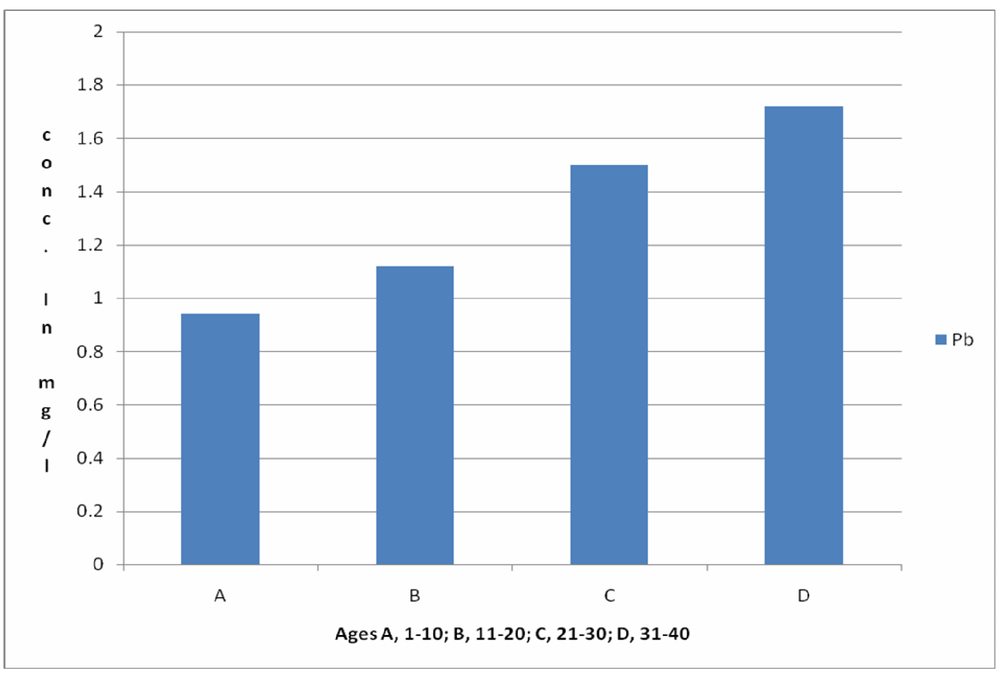

Fig II:Concentration of lead in human blood from Dareta village

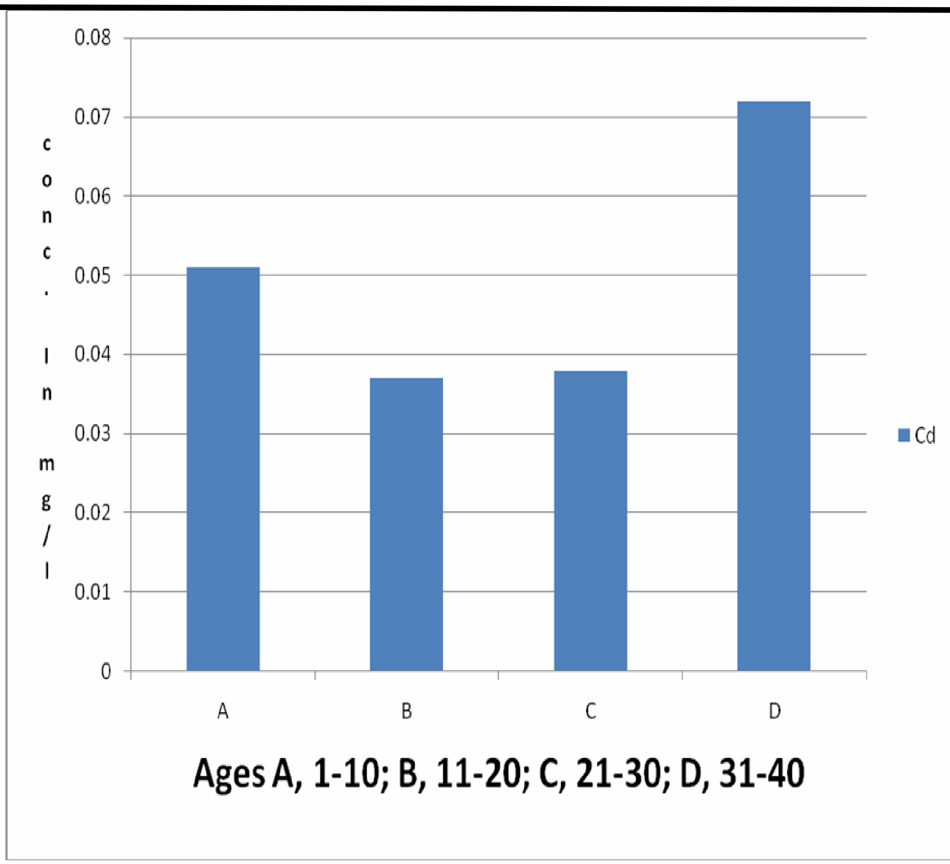

Fig III:Concentration of cadmiumin human blood from Dareta village

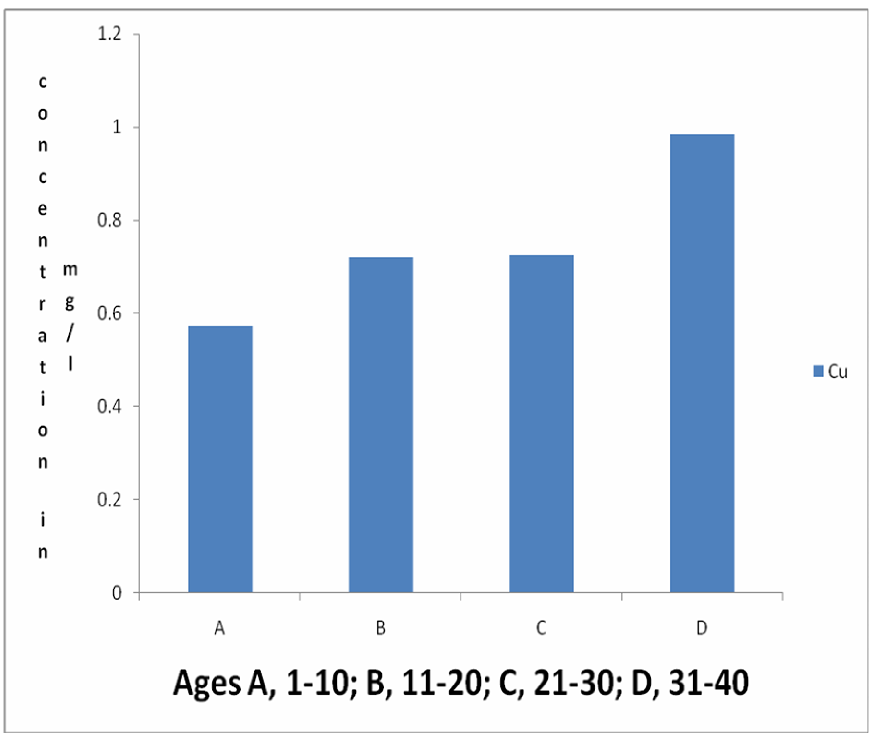

Fig IV:Concentration of copperin human blood from Dareta village

CONCLUSION

From this present study, high levels of Cd, Pb, and Zn were recorded in the blood of the sampled population. Only copper was within the world health acceptable limits, though the age range between 31-40 had average concentration of 0.984mg/l. The continuous bioaccumulation of these metals mayincrease their possibility of having toxic effects on humans and animals. To ameliorate these problems, a comprehensive study of the level of heavy metals in the ground water, streams, soils in and around Dareta village be carried out so as to carry out a remediation of the environment. The natives need to be educated on the effect of bioaccumulation of these metals. Modern mines should be built to tap these minerals.

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REFERENCES

Anetor J.I, Babalola O.O, Adeniyi F.A.A and Akingbola T.S., 2002.Observations on haemopoietic system in tropical lead poisoning. Nig. J. Physiol. Sci., 17: 9-15.

ATSDR - Agency for Toxic Substances and Disease Registry, 1990. Toxicological profile for lead. U.S. Public Health Service in collaboration with U.S. Environmental Protection Agency (EPA).

Babalola O.O, Adekunle I.M, Okonji R.E, Ejim-Eze E.E, Terebo O., 2007.Selected heavy metals in blood of male Nigerian Smokers.*Pak. J. Biol. Sci*., 10 (20): 3730-3733.

Chivers D.C., 1984. Study of plasma protein and bound copper and zinc in human health and disease. PhD Thesis, University of Leeds, 1984. Cited in Delves HT. Assessment of trace element status. Clin Endocrin Metab. 14(3): 725-736.

Durdana R.H, Shahnazimail and Shaikh G.H., 2007. Assessment of the level of trace metals in commonly edible vegetables locally available in the markets of Karachi city. Pak. J. Bot. 39(3): 747-751.

FAO/WHO Expert Committee on Food Additives, 1987. Tec. Rep. Ser. WHO: 751.

Foote J.W and Delves H.T., 1984. Albumin bound and macroglobulin bound zinc concentrations in the sera of healthy adults. J. Clin. Pathol, 37: 1050-1054.

Garrettson L.K., 1990. Lead. In: Haddad, L.M. and Winchester, J.F., eds. Clinical management of poisoning and drug over-dose. Philadelphia, W. Saunders Co. 1017-1023pp.

Gilman A.G, Rall T.W, Nies A.S and Taylor P eds. 1990. Goodman and Gilman's The Pharmacological Basis of Therapeutics. 8th ed New York, Pergamon Press.

Giroux E.L,and Henkin R.I., 1972. Competition for zinc among serum albumin and amino acids. *Biochim Biophys Acta,* 273: 64-72.

Goyer R.A., 1990. Lead toxicity: from overt to subclinical to subtle health effects. Environmental Health Perspectives, 86: 177-181.

Goyer, R.A., 1996.Toxic effects of metals. In: Casarett and Doull's Toxicology: Basic Science of Poisons. Klaassen, C.D. (Ed), New York. McGraw-Hill, 623-680pp.

Hawkes S.J., 1997. What is heavy metal? J. Chem. Educat. 74, 1374-1378.

Ibeto C. N. and Okoye C. O. B., 2009. Elevated Cadmium Levels in Blood of the Urban Population in Enugu State Nigeria. World Applied Sciences Journal. 7(10): 1255-1262.

Luckey T.D, Venugopal and Hutchson, D., 1975.Heavy metal toxicity, safety and hormology.*Qual Suf. Theime Stuttgart, Supplement*, 1:20.

MajidMumtaz, AzharSiddique, Nadia Mukhtar and Tabbsum Meyhoob, 199.Status of Trace elements level in Blood Samples of Different Age Population of Karachi, Pakistan.Tr, Jn of medical Sciences. 29: 697-699.

Martin M.H and Coughtrey, P.J., 1982.Biological monitoring of heavy metal pollution. Elsevier Science Publishing Co. Inc. NY, 2-29.

Nriagu, J.O., 1979. Global inventory of natural and anthropogenic emissions of trace metals to the atmosphere. Nature, 279: 409-411.

Prerovska I. and Pickova J., 1974.Ratio between the amount of lead in urine and faeces during treatment by CaNa2EDTA after termination of occupational exposure. PracovniLekarstvi, 26(3): 85-88.

Putnam R.D., 1986. Review of toxicology of inorganic lead. Am. Ind. Hyg. Assoc. J. 47(11): 700-703.

Roels H, Lauwerys R, Buchet J.P, Bernard A, Chettle D.R, Harvey T.C and Al Haddad I.K., 1981. In vivo measurement of liver and kidney cadmium in workers exposed to this metal. Environ. Res., 26: 217-240.

Roels H, Lauwerys R and Dardenne A. N., 1983.The critical level of cadmium in human renal cortex: a reeva-luation. *Toxicol.Lett.*, 15: 357-360.

Sax N. I. and Lewis R.J., 1989. Dangerous properties of industrial materials, 7th ed. New York, van Nostrand Reinhold.

Shibko, S.I., 1972. Possible hazards associated with ingestion of gardenvegetables by trace metals in :Helena Valley, Montana, area Environmental Study. US EPA office of Air Programmes. Publ. No. AP. 90. North Carolina, 135-144.

Yasmin N., Mughal S., Afzal F., Ahmad H., and Akhtar N.A., 2010. Portable water as a source of heavy Metals in the Blood of heart patients of Karachi, Pakistan. Journal of quality and Technology Management. Vol. VI issue II. 1-15.

Vallee B.L., 1962. "Zn," in Mineral Metabolism, Vol 2, Part 3, Comar&Bronner, Eds, Academic, New York. As cited in Stephenson, JBP Zinc phosphide poisoning. Arch Environ Health, 1967.15: 83-88

www.reuters.com/article/idUSTRE6534JE20100604