Scholarly Research Journal for Interdisciplinary Studies,
Online ISSN 2278-8808, SJIF 2019 = 6.38, www.srjis.com
PEER REVIEWED & REFEREED JOURNAL, NOV-DEC, 2019, VOL- 7/55

LEAD (Pb) CONTEMINATION IN LIVING ORGANISMS

Dev Prakash, Ph. D.

Department of Chemistry, Saraswati (P.G.) College, Hathras U.P.

Abstract

Heavy metals are naturally occurring elements which are present in varying concentrations in biosphere. They may be found in elemental form and in an array of chemical compounds. Human activities like various industrial processes, mining, foundries, smelters, combustion of fossil fuel and gasoline, and waste incinerators have drastically changed the biochemical cycles and balance of some heavy metals. Due to their non degradable nature, they persist in environment and they have acknowledged a great deal of attention in the direction of their potential health and environmental risks. The properties of selected chelating agent are critical for an effective chelation therapy. Any chelating agent which is being administered in human body should not possess adverse effects. But it has been observed that synthetic chelating agents have severe side effects on human body. It has also been suggested that these synthetic chelators should be used only in cases of acute metal poisoning or as a last choice for intractable chronic poisoning. Natural methods should be exhausted first. The concentration of lead is found to be appreciably high in the collected samples as is evident from the above tables and also can be seen in following graphs. In many of the samples, concentration of Pb has been observed above permissible limit. It may be ascribed due to a constant raise in the level of pollution in the atmosphere. The major sources of lead contamination are automobiles and industrial untreated wastewater. Besides it, young children may also get exposed by lead containing toys.

Keywords:

The steps proposed for present work are as follows:

1- *To collect blood samples of some volunteers from different areas of Hathras U. P. who were either directly or indirectly exposed to heavy metals.*
2- *To categorize the volunteers into gender and age.*
3- *To digest the collected blood samples by using concentrated nitric acid*
4- *To analyze the presence of toxic heavy metal, lead in digested blood samples qualitatively.*
5- *To determine concentration of the heavy metal in the digested blood samples quantitatively employing atomic absorption spectroscopy.*

Heavy metal toxicity is the excess of concentration of toxic heavy metals which have become concentrated as a result of human caused activities, enter in plant, animal and human tissues via inhalation, diet and manual handling, and can bind to, and interfere with the functioning of vital cellular components. Heavy metals are significant environmental pollutants; their toxicity is a problem of increasing significance for ecological, evolutionary, nutritional and environmental reasons. They are mostly found in dispersed form in rock formations. An increase in industrialization and urbanization had anthropogenic contribution of heavy metalsin the biosphere and had largest availability in soil and aquatic ecosystems. Heavy metal toxicity in plants varies with plant species, specific metal, concentration, chemical form and soil composition and pH, as many heavy metals are considered to be essential for plant growth. Heavy metals occur as natural constituents of the earth crust, and are persistent environmental contaminants since they cannot be degraded or destroyed. To a small extent, they enter the body system through food, air, and water and bio-accumulate over a period of time [1] . In rocks, they exist as their ores in different chemical forms, from which they are recovered as minerals. Heavy metal ores include sulphides, such as iron, arsenic, lead, lead-zinc, cobalt, gold, silver and nickel sulphides; oxides such as aluminium, manganese, gold, selenium and antimony [2] . Some exist and can be recovered as both sulphide and oxide ores such as iron, copper and cobalt. Heavy metals are basically recovered from their ores by mineral processing operations.

CAUSES OF HEAVY METAL CONTEMINATION: Heavy metals can be emitted into the environment by both natural and anthropogenic causes. The major causes of emission of heavy metals are the anthropogenic sources specifically mining operations [3]. In some cases, even long after mining activities have ceased, the emitted metals continue to persist in the environment. It has been reported that hard rock mines operate from 5-15 years until the minerals are depleted, but metal contamination that occurs as a consequence of hard rock mining persist for hundreds of years after the cessation of mining operations [4]. Apart from mining operations, mercury is introduced into the environment through cosmetic products as well as manufacturing processes like making of sodium hydroxide [5]. Heavy metals are emitted both in elemental and compound (organic and inorganic) forms. Anthropogenic sources of emission are the various industrial point sources including former and present mining sites, foundries and smelters, combustion by-products and traffics, Cadmium is released as a by- product of zinc (and occasionally lead) refining [6]; lead is emitted during its mining and smelting activities, from automobile exhausts (by combustion of petroleum fuels treated with tetraethyl lead antiknock) and from old lead paints [7]; mercury is emitted by the degassing of the earth's crust and by volcanic eruptions [8]. Generally, metals are emitted during their mining and processing activities. Environmental pollution by heavy metals is very prominent in areas of mining and old mine sites and pollution reduces with increasing distance away from mining sites [9]. These metals are leached out and in sloppy areas, are carried by acid water downstream or run-off to the sea. Through mining activities, water bodies are most vigorously polluted [10]. The potential for contamination is increased when mining exposes metal-bearing ores rather than natural exposure of ore bodies through erosion [11], and when mined ores are dumped on the earth surfaces in manual dressing processes. Through rivers and streams, the metals are transported as either dissolved species in water or as an integral part of suspended sediments, (dissolved species in water have the greatest potential of causing the most poisonous effects) [12]. They may be stored in river bed sediments or seep into the underground water thereby contaminating water from underground sources, particularly wells; and the extent of contamination will depend on the nearness of the well to the mining site. Wells located near mining sites have been reported to contain heavy metals at levels that exceed drinking water criteria [13]. Having broader applicability in domestic, industrial, and agricultural purposes, their prevalent distribution in the environment raises severe concerns over their potential health effects on humans. Although toxicity that arises from abrupt exposure to considerable quantities of metals (such as from occupational exposure) typically affects multiple organ systems, severity of the health outcomes of toxic metals depends on the type and form of the element, route and duration of the exposure, and, to a greater extent, on a person's individual susceptibility.

Lead is a stable, silver-gray, ubiquitous heavy metal and is detectable in all phases of the inert environment (e.g., air, water, and soil) as well as in most biological systems. It is one of the more frequently used metals in the world, and like many other metals, is seldom found in its elemental form; rather, it is found in a range of compounds, complexes, and alloys [14]. Metallic lead is used in products such as electric storage batteries, lead solder, radiation shields, pipes, and sheaths for electric cable. It may be combined with other metals to make brass alloys for plumbing fixtures. Organic lead compounds contain a lead atom bonded to carbon to form an organic lead molecule; examples include tetraethyl and tetra methyl lead (the more toxic form of the metal) that were once widely used as gasoline additives to prevent engine knock [15]. Inorganic lead salts are compounds containing lead combined with elements other than carbon. . Lead in the environment occurs naturally and as a by-product of human activity, and its concentration and presence in environmental media are highly variable.

CAUSES OF LEAD CONTEMINATION: Sources of Lead Exposure in Human The greatest part of lead emissions from stationary sources are generated by mining, smelting, and processing of lead and lead containing metal ores. The combustion of lead-containing wastes and fossil fuels in incinerators, powerplants, industries, and household causes liberation of lead into the atmosphere. As a result of the extensive use of alkyl-lead compounds as fuel additives, vehicular traffic is the prevalent source of atmospheric lead in many urban areas. This accounts for as much as 90% of all lead emissions into the atmosphere. Lead has been used in a variety of products. Water distribution systems frequently contain lead pipes or lead solder responsible for contamination of drinking water. Lead-based paint and dust contaminated by such paint also signify considerable sources of human exposure. Lead-acid batteries also put in to the contamination of all environmental media during their production, disposal, and incineration. Lead compounds may be also used as stabilizers in plastics. Other lead-based products consist of food-can solder, ceramic glazes, crystal glassware, lead jacketed cables, ammunition, and cosmetics.

TOXICOLOGY OF LEAD: Toxicological Impacts of Lead on Human Health Lead has long been one of the most intensely studied and researched toxicants, with thousands of studies that have been conducted on lead and its effects in both animals and humans. There are numerous effects that have been reported in the literature, including neurotoxicity, carcinogenicity, reproductive toxicity, and neurobehavioral or developmental effects [68]. Neurotoxicity resulting from lead overexposure is perhaps the most well documented effect, particularly in settings involving occupational exposures. Manifestations of lead toxicity in adults consist of ataxia, memory loss, and at the highest levels, coma and death. Nerve conduction is reversibly slowed in peripheral nerves at BLL of approximately 40 µg/dL. As with adults, a primary target for lead toxicity in young children is the nervous system. It is generally recognized that at BLL values of 80 µg/dL or greater, lead encephalopathy occurs, characterized clinically by ataxia, coma, and convulsions, which are often fatal. A number of cross-sectional and prospective epidemiologic studies show that even without overt toxicity, children with mildly elevated (i.e., > 10–15 µg/dL) BLL values may show increased incidence of subsequent neurological or behavioral impairment. The adverse effects of lead overexposure on the kidney have been well documented. These changes may progress to generalized kidney disease, which is characterized by disruption of function of the tubular structures. There have been some indications of auditory system processing deficits in lead-exposed children. The effects of lead overexposure on heme synthesis have been thoroughly investigated, and there is a consensus that adverse effects on hemoglobin are associated with BLL values of 50 µg/dL in adults and 80 µg/dL in children.

DETOXIFICATION OF HEAVY METALS: Numerous efforts have been made to detoxify the effect of metals once they are administered in the human body. Chelation is considered the best method used so far. In general, chelation therapy is a medical treatment that uses chelating agents to treat disorders and diseases that are induced by or result in abnormally high metal ion accumulation in the body. Chelation is one of the chemical functions that take place in the bodies of almost all living organisms. Chlorophyll, haemoglobin, cytochrome C, catalase, and peroxidase are some examples of metal ion chelators. Many of the successful drugs used in the treatment of heavy metal toxicity are dependent on chelation processes for their effective therapeutic properties. Chelating agents are organic compounds capable of linking together metal ions to form chelates or complexes. These complexes reveal a lower toxicity and are more easily eliminated from the body. Optimally effective chelation can be achieved by virtue of some combination of the basic properties of both the metal ions, chelating agents and the resulting metal complex.

CHELATING AGENTS FOR METAL DETOXIFICATION: Chelation is a chemical process that has applications in many areas, including medical treatment, environmental site rehabilitation, water purification, and so forth. In the medical environment, chelation is used to treat cardiovascular disease, heavy metal toxicity, and to remove metals that accumulate in body tissues because of genetic disorders. Chelating agents are what is needed in order to detoxify the body of these heavy metals. These agents create a chemical bond with heavy metals in the body and make them less active. Ideally, chelation therapy results in the removal, in the form of a metal chelate, of much of the toxic metal present in the blood stream. The subsequent removal from other parts of the body will depend primarily on the rate at which the metal becomes redistributed within the tissues. For use in chelation therapy, a chelating agent should be of low toxicity, not easily metabolized and capable of penetrating to metal storage sites. During Second World War, dimercaprol (also named British Anti-Lewisite or BAL), an organic dithiol compound, was developed as an experimental antidote against the arsenic-based poison gas Lewisite. After World War II, due to mass lead poisoning, in large number of navy personnel, EDTA was identified as lead chelating agent. Chelation therapy has historically been used in attempts to reduce the body burden of toxic metals in highly symptomatic patients with elevated biological markers. Chelating agents can affect metal toxicity by mobilizing the toxic metal mainly into urine. Recently a number of strategies have been suggested to minimize the problems arising from adverse effects of conventional chelating agents. One solution could be the use of any essential metals, vitamins, and amino acids. The effects of zinc and copper supplementation on the safety and efficacy of CaNa2EDTA in the treatment of lead and cadmium poisoning in experimental animals have been examined. The efficacy of some naturally occurring compounds like vitamin and amino acid was tried both as potential chelating agents and as a support to conventional chelating agents during experimental lead intoxification.

S. NO.	**Frequency**			**Concentration of Pb (in ppm)**
	Male	**Female**	**Total**	
1	04	02	06	1 -2
2	05	07	12	2-3
3	06	05	11	3-4
4	04	03	07	4-5
5	05	03	08	5-6
6	01	05	06	More than 6
Total	25	25	50	

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