

Identification of Estrogenic Heavy metals in Water Bodies Around Guwahati City, Assam, India

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Abstract: Endocrine-disrupting chemicals (EDC) are linked to human health and diseases as they mimic or block the normal functioning of endogenous hormones. Heavy metals are also considered as endocrine disrupters. The present work dealt with the detection and identification of Heavy metals (Pb, Cd, Cr, Ni, Hg) having estrogenic properties from three different sites around Guwahati city, India, well known for its polluted water. Water samples were collected and analyzed using Atomic Absorption Spectrophotometer. The estrogenic heavy metal concentration in water was in the order Pb>Cr>Ni>Hg>Cd.

Keywords: Heavy metal concentration, Estrogenic, EDC.

Introduction & Experimental

Many of the sediments in our rivers, lakes and oceans have been contaminated by pollutants. Some of these pollutants are directly discharged by industrial plants and municipal sewage treatment plants, others come from polluted runoff in urban and agricultural areas, and some are the result of historical contamination. The inorganic minerals like sodium, potassium, calcium, magnesium and heavy metals like iron, manganese, lead, mercury, chromium, cadmium, nickel, cobalt, beryllium copper *etc.*, when present above the permissible limit are harmful. Agricultural water pollution is caused by fertilizers, insecticides, pesticides, farm animal wastes and sediments. Research findings indicate that application and heavy doses of fertilizers pollute ground water through leaching. The use of various types of pesticides and insecticides in agriculture cause water pollution. Some heavy metals have been shown to have endocrine disrupting properties, interfering with the hypothalamic-pituitary-ovarian (HPO) axis. Many adverse reproductive effects related to heavy metals have been observed in both toxicological and epidemiological studies. Cadmium and Mercury have all been shown to inhibit the binding of estradiol to the ER α receptor (2, 3, 4) with Lead and Mercury having potential anti-estrogenic effects (3,5) and cadmium

having estrogenic effects (2,4,5,6). All three metals are ubiquitous in the environment; however, the main sources of lead exposure are through lead-based paint, and contaminated soil, dust and drinking water; cadmium exposure is primarily through cigarette smoke, air pollution and contaminated food and mercury exposure through fish consumption, air pollution and dental amalgams (7).

Several heavy metals stimulate proliferation of MCF-7 human breast cancer cells (3, 4, 8, 9). Cadmium interacts with estrogen receptor- α (ER- α) (3, 4) and binds to the ligand-binding domain of ER- α in cultured cells (2). Cd stimulates estrogenic responses *in vivo* (6, 10). Ovariectomized rats injected with Cd had increased uterine weight, accelerated mammary gland growth/development, and accelerated vaginal opening (VO) (6). Cd-induced estrogen-like responses were prevented by the antiestrogen ICI 182,780. Cd treatment stimulates breast cancer cell proliferation by activating ER- α -dependent Akt (protein kinase B), Erk1/2 (extracellular signal-regulated kinase), and platelet-derived growth factor receptor- α (4).

Sampling Area:

Guwahati is a major city in eastern India largest cities of eastern India. It is said to be the "Gateway" to the North-east Region. It is positioned at 26.13° N 91.77° E. The city is situated between the southern bank of the Brahmaputra river and the foothills of the Region. The three sites of water collection are The Bharalu river, Borsola Beel and the Deepor Beel

The Bharalu River (tributary of Brahmaputra) in Assam once provided potable water to thousands of people living on its banks. It was also a source of variety of fish and other aquatic flora and fauna for the people. The river is now so badly polluted that scientists have warned that unless measures are initiated on a war-footing, an unprecedented disaster is imminent.

Dipor Bil, also spelt **Deepor Beel** (*Bil* or *Beel* means "lake" in the local Assamese language), is located to the south-west of Guwahati city, in Kamrup district of Assam, India. It is a permanent freshwater lake, in a former channel of the Brahmaputra River, to the south of the main river. It is also called a wetland under the Ramsar Convention which has listed the lake in November 2002, as a Ramsar Site for undertaking conservation measures on the basis of its biological and environmental importance. Considered as one of the largest Beels in the Brahmaputra valley of lower Assam, it is categorized as representative of the wetland type under the Burma Monsoon Forest biogeographic region. The Dipor Beel is reported to provide, directly or indirectly, its natural resources for the livelihood of fourteen indigenous villages (1,200 families) located in its precincts.

Deepor Beel has been bearing the brunt of the city's unplanned development. The ills plaguing Deepor Beel are many and have assumed serious proportions. Perhaps foremost among the problems is the accumulation of municipal solid wastes, including toxic disposals, which are increasingly finding their way into the very core of the wetland. Continued discharge of the city's untreated sewerage through the Bahini and Bharalu Rivers besides the dumping of municipal solid wastes in its close proximity have pushed the wetland's pollution to alarming levels. The problem has got aggravated during the monsoons, with

rainwater sweeping large amounts of garbage from the dumping site to the beel.

The **Borsola beel** or the Sola beel, one of the notable wetlands of Guwahati city, is situated near Paltan Bazaar. It has been identified as a large water storage lake. The beel once provided a habitat for a large number of flora and fauna and receives rainwater from nearest hills and plains. Of late it has turned into a dumping ground for municipal and household wastes.

Materials and Methods:

The water samples were collected during the pre-monsoon season in the month of April 2010. Water samples were collected from different locations for preliminary assessment of heavy metals suspected to have estrogenic property. Water samples collected in glass bottles with tin foil covered with Teflon caps that had been pre-washed with detergent and deionized water, rinsed with 1:1 nitric acid and nitric acid. The samples used for the analysis of heavy metals were acidified with 10% nitric acid, stored in an ice-chest and were later conveyed to the laboratory for analysis. Preliminary digestion of water sample was necessary to release the metals associated with suspended as well as colloidal organic matters. Therefore, an extract of each water sample was prepared before processing for AAS analysis. For this, water samples were first acidified with concentrated HCl to ensure $p^H \leq 2$. Then, 5 ml concentrated HNO₃ was added to each 50 ml acidified water sample and allowed to evaporate slowly in a hot plate for reducing the volume to about 15-20 ml. The digested samples were allowed to cool to room temperature. They were then filtered through Whatman 0.45 μ m filter paper and the final volume adjusted to 50 ml with double distilled water and stored for analysis.

The heavy metals suspected to have estrogenic property (Hg, Pb, Cd, Cr, Ni, Co etc.) were estimated using flame Atomic Absorption Spectrophotometer (Perkin Elmer-2380) with air acetylene flame except mercury where N₂O-C₂H₂ flame was used. The standard solutions for calibration and all other required solutions were prepared with distilled water. Pre-reduction was carried out with KI, ascorbic acid and 5 mol/L HCl solutions. Radiation source was electrodeless discharge lamp (EDL) and argon gas and 0.5% sodium borohydride (NaBH₄) were used for hydride generation.

Metals	Bharalu River mg/L	Borsola Beel mg/L	Deepor Beel mg/L	Permissible limit (mg/L)
Cadmium (Cd)	0.012	0.012	0.020	0.003
Chromium (Cr)	0.836	0.808	0.811	0.05
Nickel (Ni)	0.018	0.024	0.023	0.05
Lead (Pb)	2.036	0.529	2.238	0.01
Mercury (Hg)	0.345	0.012	0.139	0.001

Fig1: Estrogenic heavy metal concentration in water (mg/L) in three Major water bodies of Guwahati , Assam

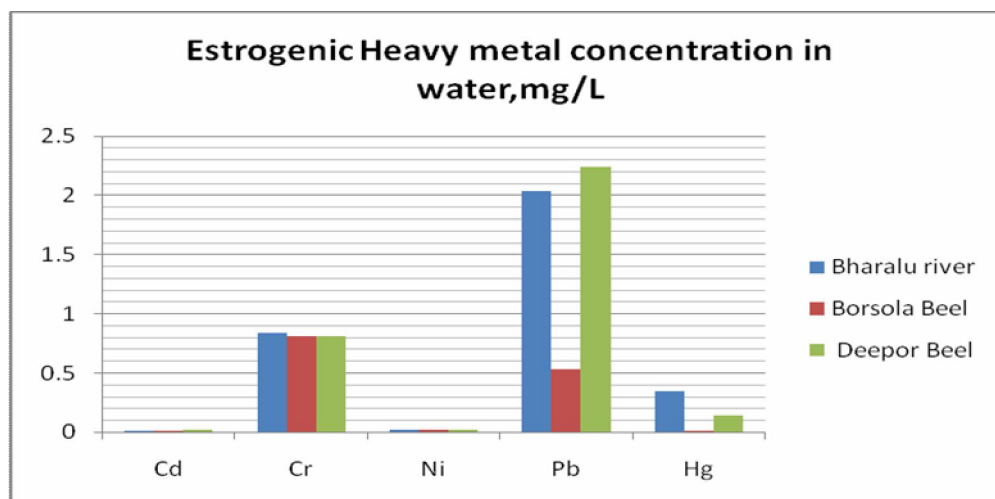


Fig 2: Showing Estrogenic heavy metal level in water samples of three Major water bodies of Guwahati, Assam

Results and Discussion

Estrogenic heavy metal analyses of the water during the study period are presented in Figure 1 and Figure 2. The results showed the presence of a number of heavy metals with estrogenic activity. It was observed that the levels of these metals in the waters were higher than the permissible limits. Cd concentration was higher in Deepor beel, while Cr was high in all three sites. Pb concentration was highest in Deepor Beel, followed by Bharalu River and Borsola Beel. Hg was seen highest in Bharalu compared to the other two sites. Ni was seen within the permitted limit. The Results demonstrated that heavy metals exceeded permissible safe levels as established by the-

-Environmental Protection Agency. The heavy metal concentration having estrogenic activity collected from the sites was in the order $Pb > Cr > Ni > Hg > Cd$.

The quality of water and sediment in the river system as well as the beels is seriously affected by pollutants which enter through drains that bring domestic as well as industrial effluents. These industrial and domestic waste waters, besides other pollutants also contain high concentration of heavy metals. The presence of elevated levels of Pb, Cd and Hg is a serious matter of concern and the potential for human exposure to heavy metals from eating fish caught in the water bodies as well as drinking water from these polluted areas.

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