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CHEMICAL ANALYSIS OF HEAVY METAL CONTAMINATION IN RIVER YAMUNA (IN SPECIAL REFERENCE TO DISTRICT MATHURA U.P.)

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Abstract

The heavy metals, which are toxic at low concentrations find their way into animals and humans through air, drinking water and food; and, can reach higher concentrations which may become poisonous due to bioaccumulation. Heavy metals concentration in Yamuna river water at Mathura U.P., Cadmium (Cd) value was found to be ranged from ND to 0.052 mg/L. The mean concentration of Arsenic (As) ranged from 0.007 to 0.103 mg/L. Lead (Pb) value varied from 0.009 to 0.130 mg/L. Chromium (Cr) content in water ranged from 0.014 to 0.252 mg/L. The Nickel (Ni) concentration ranged from 0.010 to 0.144 mg/L with the lower value obtained during the post-monsoon. Copper (Cu) varied from 0.029 to 0.189 mg/L. The concentration of Zinc (Zn) in water varied from 3.733 to 20.788 mg/L. The results revealed that heavy metals except Copper (Cu) and Mercury (Hg) were beyond the permissible limits as per Indian standard for drinking water.

Key-words: *Heavy metals, Inorganic substances, Metalloid, Bioaccumulation*

Objective: To assess Heavy Metals residues in water samples collected from river Yamuna at Mathura City Uttar Pradesh.

Experimental:

Pollutants may include inorganic substances like metal, nonmetal, metalloid and organic substances comprising compounds such as aromatic, aliphatic and polycyclic as well as halogenated and non-halogenated substances including explosives and pesticides in river water. The major pollutants of water bodies are heavy metals poorly treated and disposed into the environment from industrial and municipal sewer waste discharges. The heavy metals, which are toxic at low concentrations find their way into animals and humans through air,

drinking water and food; and, can reach higher concentrations which may become poisonous due to bioaccumulation.

Water contamination, especially by heavy metals, is a serious ecological concern even at low doses; they are non-biodegradable and have the ability to bioaccumulate via the food chain. Other metals such as Fe, Cu and Zn are essential for life, however, they can be hazardous to living-organisms if consumed taken at higher concentrations.Toxic metals may be classified as heavy, regardless of their density or atomic mass and belong to a subset of elements exhibiting metallic properties. Examples include transition metals, metalloids, lanthanides, and actinides. Heavy metals can also be defined as common transition metals and include copper, lead and zinc that can cause environmental contamination from sources such as leaded petrol, leaching metal ions from soil into rivers and lakes and effluents from industrial plants. The collected water samples were evaluated for parameters: (i) Physico-chemical parameters like Color, pH, Total Dissolved Solids (TDS), Alkalinity, Heavy Metals (Lead, Chromium, Arsenic, Cadmium, Nickel, Mercury, Copper, Iron, and Zinc), and Pesticide residues.

Heavy metals analysis of water sample: Emission spectroscopy using ICP-MS is a fast, specific and latest method for the assessment of metals concentration in water samples. After proper digestion, dissolved metals are evaluated.

Apparatus: Inductively coupled plasma–mass spectrometer. Reagents & Standards De-ionized water, Hydrochloric acid, HCl, concentration (ultra-high-purity grade), Nitric acid (HNO3), conc. (supra pure grade) Nitric acid (HNO3), 1+1: Add 500mL of conc. HNO3, to 400mL water and diluted to make 1L. Stock, standard, and other required solutions of multi-elements stock solutions (1000 mg/L) (NIST traceable) Instrument optimization/tuning solution: containing Be, Cd, Co, Cu, Ge, In, Rh, Sc, Tb, and Ti, (used for sensitivity and stability check), Ba (for doubly-charged check), Ce (for oxide check), Mg (mass calibration check), and lead (mass-calibration check). Prepared this solution in 2% nitric acid. This standard-mix has all common elements required to optimize and tune many parameters evaluated by ICP-MS. Standard calibration: A standard calibration at 5 points is recommended, from 0 to 100 µg/L. Method blank: It was a reagent water analyzed closely as a test sample. Zinc is essential micronutrients for all living organisms including humans and it's a component of proteins which are involved in DNA replication and translation, but it also has the adverse effect such as vomiting, diarrhoea, blooded urine, icterus, liver, and

kidney abnormalities and anaemia. During the study, the mean concentration of in water samples varied from 3.733 to 20.788 mg/L. Chemical reagents In this study, Certified reference material (CRM) of individual heavy metal (Pb, Cd, Cr, As & Ni) and supra-pure nitric acid (HNO3) of analytical grade were purchased from Merck. Working solution standard was made by dissolving stock solution (1000 mL) in de-ionized distilled water.

Concentraation capacity (%) as given

HM= Heavy Metal

$$\text{Percentage of HM reduced} = \frac{\text{HM reduced (mg/L)} \times 100}{\text{HM supplemented to the nutrient (mg/L)}}$$

Discussion and Results: Lately, heavy metal pollution, toxicity, and bioaccumulation have become a global issue due to its impact on health of humans, invertebrates, and fish. Heavy metals can also have long-lasting negative implications on aquatic life and as a causative agent for disease. Heavy metals concentration in Yamuna river water at Mathura U.P., Cadmium (Cd) value was found to be ranged from ND to 0.057 mg/L. The mean concentration of Arsenic (As) ranged from 0.009 to 0.121 mg/L. Lead (Pb) value varied from 0.009 to 0.130 mg/L. Chromium (Cr) content in water ranged from 0.017 to 0.285 mg/L. The Nickel (Ni) concentration ranged from 0.019 to 0.184 mg/L with the lower value obtained during the post-monsoon. Copper (Cu) varied from 0.039 to 0.198 mg/L. The concentration of Zinc (Zn) in water varied from 3.75to 22.75mg/L. The results revealed that heavy metals except Copper (Cu) and Mercury (Hg) were beyond the permissible limits as per Indian standard for drinking water.

A number of pathological modification of organs and proper functioning of the central nervous system have been attributed to Lead. Cadmium has also been found to be toxic to cardiovascular, kidneys and bones whereas arsenic is carcinogenic to humans. The heavy metal Mercury can exhibit neurotoxicity and teratogenicity, particularly in its organic form. As a result, international nongovernmental institutions such as the Food and Agricultural Organization (FAO) and the World Health Organization (WHO) have set maximum residual limits of heavy metals in food and food products for testing their safety (Kumar Snoj 2017). The levels of various heavy metals in water bodies and living things have become of paramount importance in order to comprehend their toxicity effects (Satapathy and Panda, 2018); and in recent times, there has been a quantum interest on studies on pollution of

aquatic ecosystems with heavy metals and means of its estimation in human foods, particularly, fish (Singh B. 2018).

National and International specification for drinking water

S. N.	PARAMETERS	UNIT	BIS	WHO	USEPA	EU	CHINA	CANADA
1	Pb	mg/L	0.01	0.01	0.015	0.01	0.015	0.005
2	Hg	mg/L	0.001	0.006	0.002	0.001	0.0005	0.001
3	Cd	mg/L	0.003	0.003	0.005	0.005	0.005	0.005
4	As	mg/L	0.05	0.01	0.01	0.01	0.05	0.01
5	Cr	mg/L	0.05	0.05	0.1	0.05	0.05	0.05
6	Ni	mg/L	0.02	0.02	-	0.02	-	-
7	Zn	mg/L	5	3	5	-	-	5
8	Cu	mg/L	1.5	2	1.3	0.002	-	2
9	Fe	mg/L	1	-	-	-	-	-

Suggestion : Need to develop new genetically modified strain by using CRISPER Cas9 technology for more and rapid degradation of heavy metal waste.

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