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Concentration of the Heavy Metals in Water of Udera Sthan Dam, Bihar (India)

Veena Kumari[1], Dr. Acharya Shankar[2]

Research Scholar (Zoology), Magadh University, BodhGaya

Assistant Professor, Department of Zoology, Jagjivan College, Gaya

Abstract: ***Concentration of different essential and non-essential heavy metals in water samples collected from Udera Sthan Dam was observed during present research work to determine level of metal pollution in this water body. The concentration of essential heavy metals such as Copper, Iron and Zinc in water samples were observed much lower than value prescribed by WHO and BIS/CPCB. Highest concentration of copper (9.989 µg/L), Iron (0.725µ/L) and zinc (0.028 µg/L) were observed in the month of August in the water samples of Udera Sthan Dam lowest concentration of copper (4.709 µg/L) and zinc (0.018 µg/L) were observed in the water sample obtained in September and lower concentration of Iron as 0.089 µg/L in the month of July. Highest concentration of Arsenic as 3.340 µg/L, Lead as 3.190 µg/L, Mercury as 0.310 µg/L and Nickel as 10.910 µg/L were observed in the water sample obtained during July as compared to water samples obtained during August and September. But highest concentration of cadmium as 0.923 µg/L was observed in the water sample obtained in the month of August as compared to water samples obtained in the month of July (0.099 µg/L) and September (0.051 µg/L).***

Keywords: Water Samples, Udera Sthan Dam, Essential heavy metals, Non- essential heavy metals

1. Introduction

Pollution of water bodies is a global problem. Pollutants present in any aquatic ecosystem enter into the fishes directly and indirectly through food chain. High concentration of heavy metals in water bodies and fishes is becoming a serious problem in recent years. Cadmium, Lead and Mercury affects biological functions including hormonal system of fishes leading to reduced growth due to their high level of toxic action. (Goyal *et al*., 2022). Thus, adverse impact of these pollutants on fishes results in serious economic losses.

Many rivers, dams and water reservoirs of India as well as of world receive dangerous chemicals as effluents from domestic and industrial sources. Heavy metals present in effluent remain as undegradable material and cause adverse effect on growth, reproduction and quality of fish meat. Metals come in Udera Sthan Dam through Falgu rivers. Metals come in Falgu river as a result of weathering of soils and rocks as well as from industrial effluents and agricultural runoff. Arsenic, Mercury, nickel, Lead, copper, Chromium and Cadmium are most common heavy metal pollutants in water bodies. (Jha *et al*., 2020). These pollutants come into Udera Sthan Dam from dispersed sources. Heavy metals bears atomic number greater than 20. Prasad and Ruapanwar (1990) isolated heavy metals from sediments of Ganga river and stated that heavy metals are introduced in water body mainly as a result of weathering of soil and rocks. In above mentioned perspective, concentration of heavy metals in water of Udera Sthan Dam was evaluated during present research work.

2. Materials and Method

Water samples were collected during the months of July, August and September, when the Udera Sthan Dam remain full of water. The samples of water for analysis were collected from approximately one meter from the bank of this dam. The water samples were collected in clean and pre sterilized lapelled bottles of one litre capacity. Water samples were collected during morning hours when least human intervention exists and contents of water remain uniformly distributed. The bottles containg water sampling were immediately kept in ice box and transported to laboratory for further analysis. Proper precautionary measures were taken during sampling of water to avoid any possibility of contamination.

Water samples were collected during monsoon and post-monsoon seasons when Udera Sthan Dam remain full of water. Sampling was conducted one in the month of July, August and September, 2022 around 9 to 11 AM, in sterilized bottles. The collected samples were brought to laboratory.

Collected water samples were filtered separately to remove macroscopic particles with help of whatman filters paper. No. 41 with 0.45µm pre size. The 50 ml each of filtered water samples were digested with 3:1, HCl: HNO_3 following the method prescribed by APHA (2017) to prevent the precipitation of metals.

Acid mixed water samples were digested in thermostatically controlled hot plate upto 60ºC temperature for 15 minutes. Then digested samples were cooled and again filtered through whatman filter paper No.42 and analysed by propermethod for detection of heavy metals.

Detection of copper by Neocurproine method, Iron by Phenathroline method, Zinc by Zicron method and Cadmium by Dithizone method were carried out. Detection of Nickel, Arsenic, Lead and Mercury were carried out with help of Atomic Absorption spectrophotometer and expressed as µg/L.

3. Result and Discussion

The value of permissible level of heavy metals in soft water prescribed by WHO and BIS/CPCB were presented in table-1. These data were used for comparative study with data obtained during present research work with regard to heavy metal concentration in water samples obtained from Udera Sthan Dam during month of July, August and September. The data observed for concentration of essential heavy metals such as Copper, Iron and Zinc in water samples collected from Udera Sthan Dam during July, August and September are presented in table-2. The data presented in this table indicates that the concentration of observed all three essential heavy metals remained highest in water sample obtained in the month of August as 9.989 µg/L, 0.725 µg/L and 0.028 µg/L for Copper, Iron and Zinc respectively. The lowest concentration of Copper and zinc were observed as 4.709 µg/L and 0.018 µg/L respectively in water samples obtained during. September but lowest concentration of Iron as 0.089 µg/L remained in water sample obtained in the month of July.

Thus, it became evident from the data mentioned in this table that the concentration of essential heavy metals shows variable trend during the three months of observation such as July, August and September.

Table 1: Permissible level of Heavy Metals in Water (µg/L)

S. No.	Heavy Metals	Permissible Limit	
		WHO	BIS/CPCB
1.	Copper	2000	1500
2.	Iron (Fe)	2000	1000
3.	Zinc (Zn)	3000	5000
4.	Arsenic (As)	10	10
5.	Cadmium (cd)	03	03
6.	Lead (Pb)	10	10
7.	Mercury (□g)	01	01
8.	Nickel (Ni)	20	20

WHO= World Health Organization, 1996.
BIS= Bureau of Indian Standards, 2012.
CPCB= Central Pollution Control Board, 2012.

Table 2: Essential Heavy Metal Concentration in Water (µg/L) of Udera Sthan Dam

S. No.	Essential Heavy Metals	Concentration in water		
		July	August	September
1.	Copper (Cu)	5.145±0.130	9.989±0.214	4.709±0.820
2.	Iron (Fe)	0.089±0.011	0.725±0.020	0.423±0.020
3.	Zinc (Zn)	0.024±0.008	0.028±0.004	0.018±0.003

n = 3, ± SD

Table 3: Non-essential Heavy Metal concentration in Water (µg/L) of Udera Sthan Dam

S. No.	Non-essential Heavy Metals	Concentration in water		
		July	August	September
1.	Arsenic (As)	3.340±0.931	2.787±0.720	0.580±0.074
2.	Cadmium (Cd)	0.099±0.007	0.923±0.051	0.05±0.009
3.	Lead (Pb)	3.190±0.728	0.793±0.082	0.277±0.093
4.	Mercury (µg)	0.310±0.002	0.133±0.006	0.096±0.011
5.	Nickel (Ni)	10.910±1.073	5.907±0.347	4.188±0.920

n = 3, ± SD

The data obtained for concentration of non-essential heavy metals such as Arsenic, Cadmium, Lead, Mercury and Nickel in water samples obtained during months of July, August and September from Udera Sthan Dam were presented in table-3. Among these non-essential heavy metals, the maximum concentration was observed of Nickel as 10.910 µg/L in water sample obtained during July. The concentration of Nickel showed decreasing trend from the month of July to September and minimum concentration as 4.188 µg/L was observed in water sample obtained in the month of September. The concentration of Arsenic in water samples also showed decreasing trend from July to September. Maximum concentration of Arsenic was observed as 3.340 µg/L in the month of July and minimum as 0.580 µg/L,0.923 µg/L and 0.051 µg/L during the month of July, August and September respectively. Thus it became evident that concentration of Cadmium showed gluctuating trend. The concentration of Lead in water samples also showed decreasing trend from July to September. The concentration of Lead was observed as 3.190 µg/L, 0.793 µg/L and 0.277 µg/L during July, August and September respectively. The concentration of Mercury also showed decreasing trend from July to September.

The mercury concentration in water samples were observed as 0.310 µg/L, 0.133 µg/L and 0.096 µg/L during July, August and September respectively.

Thus, it became evident that the concentration of most of the observed non-essential heavy metals in water showed decreasing trend from July to September except cadmium. The concentration of Cadmium remained highest in the month of August.

Banares and Alvarez (2015) examined the heavy metal concentration of heavy metals in some rivers of Philippines. They observed that cadmium remain present in sediment of Antiao river but remained in low concentration. They pointed out that heavy metals in excess amount disturbs physiological and psychological aspects of human health. The results of present research work shows conformity with results obtained by Banares and Alvarez (2015).

Singh and Singh (2014) examined the concentrations of heavy metals in water samples obtained from four sampling sites of river Ganga near Gajipur and observed that all heavy metals remained above permissible limits in all water samples examined by them. They pointed out that metals remain present in water body as soluble and insoluble forms. Such as ionic, inorganic and organic state. They also remain present as colloids or suspended particulate matter. They observed iron in range of 2.0-3.4 mg/ℓ, copper in range of 12.13- 16.80 mg/ℓ, zinc in range of 6.52-10.2 mg/ℓ, nickel in range of 1.20-4.20 mg/ℓ, chromium in range of 1.0-2.8 mg/ℓ and lead in range of 1.05-3.20 mg/ℓ in water samples examined by them in the year 2012. Goyal *et al*. (2022), Jha *et al*. (2020) and Meghwal and Parihar (2022) analyzed the heavy metal concentration of different water bodies of Uttar Pradesh, West Bengal and Rajasthan and obtained significant results. Vukovic *et al*. (2014) stated that heavy metals enters into aquatic ecosystem as inorganic complexes or hydrated ions. Dixit *et al*. (2015) presented an overview of criteria related to bioremediation

of heavy metals from aquatic ecosystem. Suthar *et al*. (2009) conducted a research study related to assessment of water of river Hindon (India). Paul (2017) examined the heavy metal pollution in water of river Ganga in West Bengal. Thus, present research work was conducted as a step ahead in accordance with the works reported in literature.

4. Conclusion

Highest concentration of essential heavy metals such as Copper, Iron and Zinc were detected in the water sample obtained in the month of August as compared to water samples obtained in July and September. The concentration of non-essential heavy metals such as Arsenic, Lead, Mercury and Nickel remained highest in the water sample collected in the month of July and concentration of these heavy metals showed decreasing trend from July to September. Thus periodic analysis of the heavy metal concentration in water of Udera Sthan Dam is essential for protection of local human population from deleterious diseases.

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