



RESEARCH PAPER

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Analysis of heavy metals in River Indus at Biliani Khyber Pakhtunkhwa, Pakistan

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Abstract

Water plays a vital role for all living organism. If there is no water, there will be no life in the universe. Water is too much essential for the survival of life. The current study was conducted to evaluate the concentration of heavy metals in River Indus at Biliani site Khyber Pakhtunkhwa, Pakistan. For this purpose water samples were collected from three sites of the River i.e. upstream, midpoint and downstream respectively. The concentration of heavy metals such as cadmium, chromium, copper, manganese, lead, and zinc was recorded Zn 1.18-1.71 ppm; Cu 1.05-1.26 ppm; Cd 0.06-1.38 ppm; Pb 0.05-1.24 ppm; Cr 0.04-0.19 ppm and Mn 0.03-0.08 ppm respectively.

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Introduction

Zinc is a major inorganic pollutant, which has inhibitory and stimulating effects on the growth along with accumulation in plants (Kumar, 1989). Zinc inhibits transporter-mediated glutamate uptake (Vandenberg *et al.*, 1998) and depending on concentration, can inhibit or potentiate glycine receptors (Khan and Wu, 1999). It is also known that zinc is toxic to neurons. Studies in animal models suggest that endogenous zinc mediates neuro degeneration resulting from ischemia (Koh *et al.*, 1996; Suh *et al.*, 1996). It has been suggested that increased intracellular zinc may result in mitochondrial impairment and generation of reactive oxygen species (Dineley *et al.*, 2003). These microorganisms actively contribute to the amelioration of the effluent quality, since the majority of them feed upon dispersed bacteria (Madoni, 2000). Heavy metal uptake processes by biological cells are known under the general term of biosorption. These phenomena include both passive adsorption of heavy metals to the cell walls and metabolically mediated uptake by the cells (Gadd, 1990). Water is essential for life and is the most important single product in human civilization. Water is an amazing substance constantly moving from sea to land and back again. It shapes the earth's surface and moderates our climate. It is the medium in which all living process occurs. Water dissolves nutrients and distributes them to cells, regulates body temperature, supports structures and removes waste products from the body (Cunningham and Cunningham, 2003; Mani *et al.*, 2013). Rivers systems are being greatly polluted with heavy metals released from domestic wastes, industrial effluents and agricultural runoff (Mendil *et al.*, 2005). Assessment of heavy metals were carried out by Usman *et al.* (2017a) to examine the concentration of health hazard toxic metals in in River Kabul at Khazana Suger Mill Peshawar KP, Pakistan. Heavy metals concentration obtained from the present study was Zn 1.13-201 ppm; Cu 0.55-0.9 ppm; Cd 0.02-1.22 ppm; pb 1.231.84 ppm; Cr 0.21-1.2 ppm and Mn 0.02-0.05 ppm respectively. A research work was conducted by Usman *et al.* (2017b) to estimate the

amount of heavy metals in River Kabul at Kond Marble factory KP, Pakistan. The concentration of heavy metals obtained was Zn 1.2-231 ppm; Cu 0.3-1.89 ppm; Cd 0.13-0.75 ppm; Pb 1.13-0.96 ppm; Cr 0.01-0.02 ppm and Mn 0.11-0.44 ppm respectively. Atlas *et al.* (2017) find out the amount of heavy metals such as Zn, Cu, Cd, Pb, Cr and Mn in River Kabul at Sardaryab Khyber Pakhtunkhwa, Pakistan. The heavy metals analyzed in the present research were in the range of Zn 1.14-1.86 ppm; Cu 1.03-1.22 ppm; Cd 0.12-0.89 ppm; Pb 0.08-1.08 ppm; Cr 0.02-0.12 ppm and Mn 0.03-0.29 ppm respectively. Evaluation of heavy metals were carried out by Afridi *et al.* (2017) in the common carp (*Cyprinus carpio*) collected from two different water bodies the Tarbela dam, District Haripur, and River Soan District Rawalpindi Pakistan. Concentration of Mn, Ni, Cd, Cu, Pb, Se, Zn were determined in five tissues the gills, skin, kidney, liver and muscle. The concentration of detected metals found in different tissues of same species varied for Mn: 0.43-4.96, Ni: 0.49 – 1.60, Cd: 0.06 – 0.08, Cu: 0.36 – 0.81, Pb: 0.50 – 0.74, Se: 6.17 – 17.05, Zn: 0.59 – 3.74µg/g wet wt. Measurement of heavy metals was conducted by Fawad *et al.* (2017) to know the rate of bioaccumulation of Chromium (Cr (III) in the gills, intestine, and skin and its acute toxicity to goldfish (*Carassius auratus*) fingerlings. The behavioral change occurs in the fish is that all the fingerlings of goldfish come to the corner of the aquarium and their appetite also decrease due to chemical effect. Amount of heavy metals were analyzed by Usman *et al.* (2017c) in different sites of River Kabul on Rohu, *Labeo rohita* (Hamilton). The highest concentrations of Zn (6.00 ppm) was found at Jehangera Upper site, Cu (3.05 ppm) at Dalda Oil Mill Nowshera site, Cr (1.05 ppm) at Jehangera Lower, Mn (2.00 ppm) at Jehangera Lower, Pb (0.02 ppm) at Dalda Oil Mill Nowshera site and Cd (3.0 ppm) at the Jehangera Upper site. Quantity of health hazard metals was detected by Usman *et al.* (2017d) in natural waters of river Kabul, KP Province, Pakistan. The concentrations of the metals recorded were in the range as: Pb 0.06-4.41 ppm; Zn 4.11-7.11 ppm; Cd 0.42-1.46 ppm; Cu 1.07-3.86 ppm; Mn 0.06-2.11 ppm

and Cr 0.05-2.11 ppm. The present investigation aimed to concluded that Cd, Cu, Pb and Cr were found above the permissible limits.

Materials and methods

Study Area

Biliani is very popular site of the River Indus located in Hazara Division Kyber Pakhtunkhwa Pakistan. This point of the river consisting high water bodies. This Area of the River is very wide and speed of the water is also very high. Dominant family over here is almost Cyprinidae fauna. This site is very appropriate for wild life conservation. Most vertebrates and invertebrates fauna is present in this area. For example Jackal, wolf, Porcupine and dragonflies are very popular.



Fig. 1. Map of River Indus at Biliani site Khyber Pakhtunkhwa, Pakistan.

Sampling of Water

Water samples were stored in clean and dry plastic bottles with screw caps and labeled. The freshly collected samples were analyzed for Heavy metals analysis at GC University Faisalabad lab by using atomic absorption

Method for preparation of stock solution

The stock solution was prepared as 1000 ppm = 1000mg/l. Then 100 ppm solution was prepared from stock solution using serial dilution equation of $C_1V_1 = C_2V_2$

Determination of heavy metals in water

The water samples were first filtered with the help of filter paper and then taken in 250ml of glass bottles and subjected to the atomic absorption

spectrophotometer (Zn, Cu, Cd, Mn, Cr, Pb) at GC University Faisalabad lab.

Results and discussion

The present investigation was conducted to assess the concentration of heavy metals in River Indus at Biliani site Khyber Pakhtunkhwa, Pakistan. For this purpose water samples were collected from three sites of the River i.e. upstream, midpoint and downstream respectively. The concentration of heavy metals such as cadmium, chromium, copper, manganese, lead, and zinc was recorded Zn 1.18-1.71 ppm; Cu 1.05-1.26 ppm; Cd 0.06-1.38 ppm; Pb 0.05-1.24 ppm; Cr 0.04-0.19 ppm and Mn 0.03-0.08 ppm respectively. From the present investigation, it can be concluded that Cd, Cu, Pb and Cr were found above the permissible limits. Water plays a vital role for all living organism. If there is no water, there will be no life in the universe. Water is too much essential for the survival of life. Concentration of heavy metals was analyzed by Usman *et al.* (2017e) in the River Kabul Shah Alam tributary, Peshawar Khyber Pakhtunkhwa, Pakistan. The concentration of the heavy metals were Zn 1.2-2.0 ppm; Cu 0.17-1.48 ppm; Cd 0.2-0.69 ppm; Pb 1.01-1.23 ppm; Cr 0.04-2.01 ppm and Mn 0.01-0.82 ppm respectively. Heavy metals were recorded by Usman *et al.* (2017f) to study the water quality of the River Kabul at Dalda Oil Mill Nowshera Khyber Pakhtunkhwa, Pakistan. Water samples were collected from three different sites along the course of the River Kabul at Dalda Oil Mill Nowshera. The amount of heavy metals such as cadmium, chromium, copper, manganese, lead, and zinc were determined using atomic absorption spectrophotometer. The majority of the samples were found to exceed from the permissible limit recommended by WHO. The ranges of the heavy metals obtained during the present research were Zn 2.11-2.8 ppm; Cu 0.3-2.23 ppm; Cd 0.12-0.88 ppm; Pb 0.02-2.06 ppm; Cr 0.02-0.16 ppm and Mn 0.41-1.1 ppm respectively. A study was conducted by Usman *et al.* (2017g) to analyze the concentration of toxic pollutant i.e. heavy metals (Zn, Cu, Cd, Pb, Cr and Mn) in River Kabul at Warsak Peshawar KP, Pakistan.

In this study the amount of heavy metals recorded were Zn 1.19-1.7 ppm; Cu 0.13-0.75 ppm; Cd 0.02-0.32 ppm; Pb 1.01-0.03 ppm; Cr 0.00-0.00 ppm and Mn 0.01-0.03 ppm respectively. A research study was conducted by Farhan *et al.* (2016) to determine the concentration of some heavy metals (Fe, Ni, Cu, Cr, Cd, Pb and Zn) in water and soil samples of four different dams located in the area of Karak, KP, Pakistan. The results obtained showed that the average value of Fe and Zn in both water and soil samples were found to be higher than other metals. A survey was carried out by Rehman *et al.* (2015) on Bannu Dam's and Damai Stream during Breeding Season of Fishes. The order of heavy metals concentration in water and soil of damai stream and dam's was: Fe $53.17 \pm 0.2 \text{ mg/L}$ (Gomalzam dam soil sample) and $46.12 \pm 0.1 \text{ mg/L}$ (Gomalzam dam water sample), Pb $5.53 \pm 0.32 \text{ mg/L}$ (Gomalzam dam water sample) and $5.097 \pm 0.17 \text{ mg/L}$ (Gomalzam dam soil sample), Cu $6.05 \pm 0.11 \text{ mg/L}$ (Gomalzam dam water sample) and $3.50 \pm 0.01 \text{ mg/L}$ (Barganatu dam soil sample), Zn $3.38 \pm 0.03 \text{ mg/L}$ (Damai stream soil sample) and $2.27 \pm 0.01 \text{ mg/L}$ (Baran dam soil sample), Ni $0.77 \pm 0.01 \text{ mg/L}$ (Baran dam water sample) and $0.54 \pm 0.01 \text{ mg/L}$ (Baran dam soil sample), Cd $0.67 \pm 0.01 \text{ mg/L}$ (Damai stream soil sample) and $0.23 \pm 0.02 \text{ mg/L}$ (Damai stream water sample), Cr $0.12 \pm 0.01 \text{ mg/L}$ (Barganatu dam soil sample) and $0.08 \pm 0.03 \text{ mg/L}$ (Baran dam water sample). Another research was conducted by Rehman *et al.* (2016) to

evaluate heavy metal of Molluska Shell, Water and Soil Collected from Darmalak Dam, Tehsil Lachi District Kohat. The high concentration of heavy metals found in the sediment is due to the anthropogenic inputs and fishing activity. Heavy metals were detected by Akhwan *et al.* (2016) to explore the concentration of heavy metals in soil and water of Kohat dams with respect to fish production, KP, Pakistan. The average value of Pb in water (0.24 mg/L) was found to be higher than the allowed value i.e. 0.01 mg/L . The average values of Zn, Cd, Cr and Cu in water are in the range of 0.52 mg/L , 0.32 mg/L , 0.082 mg/L and 0.01 mg/L which are below than the permissible value. Ni was found absent in all water samples. The average value of the heavy metals were also found in soil and found in the range of 1.43 mg/L (Pb), 0.092 mg/L (Ni), 0.92 mg/L (Zn), 0.039 mg/L (Cr), 0.134 mg/L (Cu) and 0.20 mg/L (Cd), in which the value of Ni and Pb were found to be higher than the permissible value and other were found below the allowed level according to WHO. A study was conducted by Khan *et al.* (2017) to find out contamination of toxicological effect on environment as well as on public health and is an emerging problem in District Quetta. On average, the Antimony (Sb) ($0.028 \pm 0.022 \text{ mg/L}$) was above the WHO standard limits while Arsenic (As) ($0.006 \pm 0.0094 \text{ mg/L}$) was below the WHO standard limits.

Table 1. Concentration of heavy metals (ppm) in River Indus at Biliani site KP, Pakistan.

S.No	Metals	U.S	M.P	D.S	Permissible limits
1	Zn	1.18	1.71	1.26	5.0 mg/l
2	Cu	1.05	1.26	1.08	0.05 mg/l
3	Cd	0.06	1.38	0.15	0.05 mg/l
4	Pb	0.05	1.24	0.08	0.05 mg/l
5	Cr	0.04	0.19	0.06	0.05 mg/l
6	Mn	0.03	0.08	0.04	50-70 mg/l

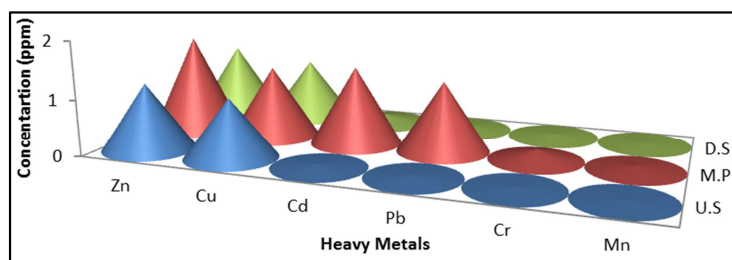


Fig. 2. Concentration of heavy metals (ppm) in River Indus at Biliani site KP, Pakistan. U.S (Up stream); M.P (Mid point); D.S (Down stream).

Conclusion

The current survey was carried out in River Indus at Biliani site Khyber Pakhtunkhwa Pakistan to find out the amount of heavy metals. From the present investigation, it can be concluded that Cd, Cu, Pb and Cr were found above the permissible limits while Zn and Mn lies within the permissible limits. This high concentration of toxic metals can effect on water quality as a result aquatic flora and fauna are adversely affected.

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