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Determination of heavy metals (Cu, Cd, Pb, Cr, Zn and Mn) in River Siran at Beer Khyber Pakhtunkhwa, Pakistan

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Abstract

The current study was designed to explore heavy metals in River Siran at Beer Khyber Pakhtunkhwa, Pakistan. The amount of heavy metals obtained in the present research was in the range of Zn 1.15-1.75 ppm; Cu 1.03-1.25 ppm; Cd 0.07-1.37 ppm; Pb 0.05-1.26 ppm; Cr 0.03-0.19 ppm and Mn 0.09-0.11 ppm respectively. The present investigation reviled that Cu, Cd, Pb and Cr were above the permissible range while Zn and Mn were within range. The present research summarized that this sampling station of river Siran was impure by the heavy metals.

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Introduction

The water of rivers plays an important role in development of the country. The rivers serve as a source of water supply to meet our domestic, industrial, agricultural, fisheries and power generation needs. It is agonizing to see that the same water resources are also utilized for the disposal of domestic and industrial wastes which ultimately leads to water pollution (Kumar, 2002). Heavy metals have been listed by the US Environmental Agency (USEPA) based on their potential for human exposure and health risk (Birungi, 2007). The main sources of heavy metal pollution of the agriculture, industry and metropolitan cities, the bioaccumulation of toxic heavy metals in fish species from different aquatic systems is dependent on their foreign polluted substances. The distribution of heavy metals in water, sediments and fish play a key role in detecting Sources of heavy metal pollution in aquatic ecosystem (Forstner and Wittman, 1981). Heavy metals such as copper, iron, chromium and nickel are essential metals since their play an important role in biological systems, whereas cadmium and lead are non-essential metals, as they are toxic, even in trace amounts (Fernandes *et al.*, 2008). Therefore, monitoring these metals is utmost necessary for safety assessment of the environment and human health in particular. Biologically or chemically these metals cannot be degraded, and thus may either accumulate locally or be transported over long distance (Batayneh, 2012).For the normal metabolism of the fish, the essential metals must be taken up from water, food or sediment (Canlı and Atlı, 2003). These essential metals can also produce toxic effects when the metal intake is excessively elevated (Tüzen, 2003). Evaluated heavy metals concentration in river systems are often considered indicators of anthropogenic influence and they are potential risk to the natural environment. Therefore, it is important to assess and track the abundance of these heavy metals. It is well known that the metals toxicity and bioavailability depends on other speciation, either in water or sediment. Heavy metals are distributed in sediments in four fractions, as exchangeable bound, iron– manganese oxide, organic matter and residual species (Dean *et al.*, 2002). The pollution of the aquatic environment with heavy metals has become a worldwide problem during recent years, because they are indestructible and most of them have toxic effects on organisms (MacFarlane and Burchett, 2000). Amount of heavy metals were analyzed by Usman *et al.* (2017a) 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. Rehman *et al.* (2016) conducted a research work 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. Another study was carried out by Ullah *et al.* (2016) to estimate 96hr LC50 value of Cadmium sulphate for the fish, *Labeo rohita*. The results showed that the median lethal concentration (LC50) of Lead Nitrate for the fish, *Labeo rohita* is 24 mg/l. The susceptibility of *Labeo rohita* to the lethal effect of Cadmium sulphate was dependent on duration as well as on concentration. The mortality of the fishes is directly proportional to the concentration. Quantity of health hazard metals was detected by Usman *et al.* (2017b) 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. Concentration of heavy metals was analyzed by Usman *et al.* (2017c) 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. According to Nazir *et al.* (2015) Heavy metals are bio accumulated and bio transferred both by natural and anthropogenic sources. Results showed that concentrations of cadmium, chromium, iron and lead in water were recorded above the permissible limits

set by WHO while zinc and copper were recorded below the permissible limits and no concentration of nickel was recorded in water samples. The current study was to find out the heavy metals (Cu, Cd, Pb, Cr, Zn and Mn) in River Siran at Beer Khyber Pakhtunkhwa, Pakistan.

Materials and methods

Study area

Beer site of the River Siran is very attractive place on the bank of river Siran. Over here, green fields are present. Water flow is slow in this site. It's also providing recreation place for the local peoples. A lot of trees are presents surrounding. This site is very popular especially wild life point of view. Due to tourism load this site is badly affected.

Fig. 1. Map of River Siran at Beer site KP, Pakistan. Blue arrow show sampling point of the site.

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 = 1000 mg/l. Then 100 ppm solution was prepared from stock solution using serial dilution equation of C1V1 = C2V2 *Determination of heavy metals in water*.

The water samples were first filtered with the help of filter paper and then taken in 250 ml of glass bottles and subjected to the atomic absorption spectrophotometer (Zn, Cu, Cd, Mn, Cr, Pb) at GC University Faisalabad lab.

Results and discussions

The concentration of heavy metals recorded in the current research was in the range of Zn 1.15-1.75 ppm; Cu 1.03-1.25 ppm; Cd 0.07-1.37 ppm; Pb 0.05-1.26 ppm; Cr 0.03-0.19 ppm and Mn 0.09-0.11 ppm respectively. Many researcher contribute their work like research work was conducted by Usman *et al.* (2018h) to find out the concentration of heavy metals in River Dor at Dobandi site Khyber Pakhtunkhwa, Pakistan. In this study three sampling stations (Upstream, Mid-Point and Downstream) were selected in River Dor at Dobandi site which were away from one another 100 meter distance. The concentration of hazard heavy metals recorded were Zn 1.151.89 ppm; Cu 1.05-1.27 ppm; Cd 0.07-1.39 ppm; pb 0.06-1.27 ppm; Cr 0.03-0.19 ppm and Mn 0.03-0.05 ppm respectively. A research work was conducted by Usman *et al.* (2017d) 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. An Investigation was carried out by Usman *et al.* (2018i) to explore the quantity of health hazard toxic metals in River Dor at Jama site Khyber Pakhtunkhwa, Pakistan. In this analysis the concentration of the toxic heavy metals obtained was Zn 1.12-1.86 ppm; Cu 1.03-1.24 ppm; Cd 0.04-1.35 ppm; Pb 0.05-1.28 ppm; Cr 0.02-0.17 ppm and Mn 0.01-0.03 ppm respectively.

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

S.No	Metals	U.S	M.P	D.S	Permissible limits
1	Zn	1.15	1.75	1.34	5.0 mg/l
2	Cu	1.03	1.25	1.09	0.05 mg/l
3	Cd	0.07	1.37	0.15	0.05 mg/l
4	Pb	0.05	1.26	0.08	0.05 mg/l
5	Cr	0.03	0.19	0.07	0.05 mg/l
6	Mn	0.09	0.11	0.09	50-70 mg/l

Assessment of heavy metals were carried out by Usman *et al.* (2017e) 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 survey was conducted by Usman *et al.* (2018j) to evaluate concentration of heavy metals in River Dor at Mankarai Khyber Pakhtunkhwa, Pakistan. The concentration of heavy metals obtained was Zn 1.13-1.86 ppm; Cu 1.03-1.25 ppm; Cd 0.04-1.35 ppm; Pb 0.05-1.28 ppm; Cr 0.05-0.17 ppm and Mn 0.03-0.07 ppm respectively. A survey was carried out by Usman *et al.* (2017f) to find out the concentration of heavy metals in Jhanjira Upper site of the River Kabul KP, Pakistan. The results obtained from the current study were in the range of Zn 1.11-1.97 ppm; Cu 1.05-1.63 ppm; Cd 0.11-0.89 ppm; Pb 0.07-1.07 ppm; Cr 0.01-0.11 ppm and Mn 0.02-0.28 ppm respectively. A 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 (Usman *et al.*, 2018k).

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±0.022 mg/L) was above the WHO standard limits while Arsenic (As) (0.006±0.0094 mg/L) was below the WHO standard limits. In a study carried out to assess concentration of heavy metals in River Indus at Pattan site Khyber Pakhtunkhwa, Pakistan. Water sampling were carried out from the three selected sites of the River at Pattan site like The Upstream, Mid-Point and Downstream. Heavy metals obtained were Zn 1.16-1.89 ppm; Cu 1.04-1.25 ppm; Cd 0.56-1.32 ppm; Pb 0.07-1.27 ppm; Cr 0.02-0.18 ppm and Mn 0.04-0.09 ppm respectively (Usman *et al.,* 2018l). Analysis of heavy metals was determined by Usman *et al.* (2017g) to explore the amount of heavy metals in River Kabul at Khairabad water KP Pakistan. The heavy metals recorded were Zn 1.5-1.59 ppm; Cu 1.15-1.94 ppm; Cd 0.02-0.05 ppm; Pb 0.15-0.73 ppm; Cr 0.01-0.02 ppm and Mn 0.07-0.21 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 (*Cyprinius 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.

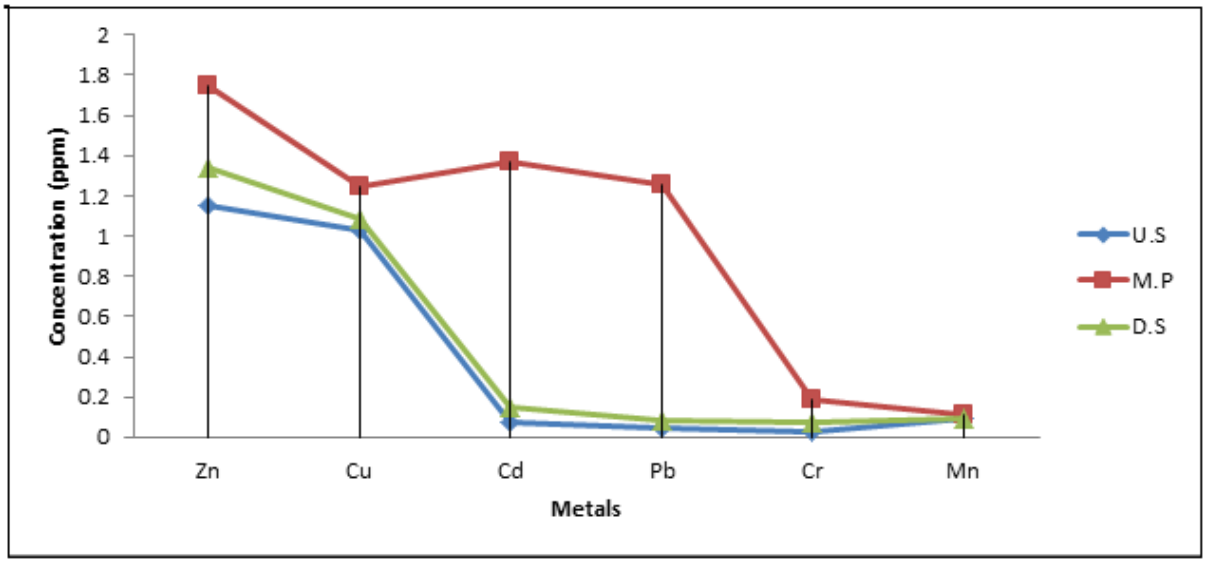

Fig. 2. Concentration of heavy metals (ppm) in River Siran at Beer site KP, Pakistan. U.S (Up stream); M.P (Mid-point); D.S (Downstream).

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 – 3.74 µg/g wet wt.A study was design to find out concentration of heavy metals in River Indus at Thakot Khyber Pakhtunkhwa, Pakistan. Heavy metals concentration obtained from the present study was Zn 1.15-1.86 ppm; Cu 1.06-1.25 ppm; Cd 0.05-1.39 ppm; Pb 0.03-1.22 ppm; Cr 0.04-0.13 pm and Mn 0.02-0.06 ppm respectively. In this examination Cu, Cd, Pb and Cr were above the permissible limits (Usman *et al.,* 2018m). Measurement of heavy metals was conducted Fawad *et al.* (2017) to find out 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.

Conclusion

The current investigation results reviled that Cu, Cd, Pb and Cr were above the standard range while other two health hazard heavy metals Zn and Mn were lies within permissible level.

From the current survey, it can be summarized that this site of sampling was impure due to health hazard contamination.

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