Research Article

# Heavy Metals Detection of a Carp Species, *Barilius bendelisis* (family cyprinidae) Collected from the Shnebaye Stream of District Karak, Khyber Pakhtunkhwa Province, Pakistan

**Zubia Masood[1], Asim Ullah[1], Neelam Firdous[1], Sidra Tul Muntaha[1], Laila Manzoor[1], Sajeela Naz[1], Shama Zaman[1], Waqas Ahmad[2], Fahim Ullah[2], Hameed Ur Rehman[2]**

[1]Department of Zoology, Kohat University of Science and Technology, Kohat-26000, KPK, Pakistan.

[2]Department of Chemistry Kohat University of Science and Technology, Kohat-26000, KPK, Pakistan.

***Corresponding author's E-mail:** Hameedu83@yahoo.com

**Accepted on:** 05-08-2014; **Finalized on:** 30-09-2014.

**ABSTRACT**

The present study is focused on heavy metals analysis profile of *Barilius bendelisis*, plant (spirogyra), and water samples of the Shnebaye stream. The samples were collected from Shnebaye stream karak and then brought to the Department of Zoology KUST for the proper identification of fish sample. The plant sample brought to the Department of Botany KUST for identification, and then for further process of heavy metals analysis, the samples were brought to the Department of Chemistry KUST. The fish samples were divided into three parts; e.g. head, abdomen and tail. In addition to the fish body regions, heavy metal concentration of water, spirogyra plant and bottom soil of Shnebaye stream was also determined in the present study. The recorded level of the values of these heavy metals in plant (spirogyra) and soil were Cd>Ni>Cu>Zn and Cd>Ni>Cu>Zn respectively, while the values of selected heavy metals in surface, middle and startup water of stream were as follows; Ni>Cu>Cd>Zn (surface water), Ni>Cu>Cd>Zn (mid water) and Ni>Cu>Cd>Zn(startup water), respectively.

**Keywords:** AA Spectrophotometer, *Barilius bendelisis*, Heavy metals, Spirogyra, Water.

## INTRODUCTION

The term heavy metal is a general term which applies to group of metals and metalloids with atomic density greater than water.[1] They are also known as trace elements because they occur in minute concentrations in biological systems. These metals may build up in biological systems and become significant health hazard. Heavy metals are the most important toxic pollutants which threaten the environment especially watery perimeters. These pollutants are created naturally or through the mines near natural water resources, entrance of industrial sewage, different petrochemical industries and the leakage of oil, gas etc. They can directly or indirectly threaten human through the food chain.[2] The fresh and marine water contamination with a wide range of pollutants has become a serious matter of concern over the last few decades.[3] The heavy metals released from domestic, industrial and other anthropogenic activities extensively contaminated the natural aquatic systems.[4,5] It is well known that the heavy metal contamination could have effects on the ecologically balanced environment via altering the aquatic organisms[6-9] especially to the fish community.[10] Through different biochemical reactions such bioconcentration, bioaccumulation and ultimately biomagnified these metals reach to the food chain and eventually threatened the health of humans by seafood consumption.[11-13] Over the last few years the problems of pollutions from heavy metals has caused increasing concern. Some of the more dangerous effects of elements present in the environment are summarized here:

### Cadmium

Cadmium, a naturally occurring element found in the earth's crust, was discovered in 1817, but was not used commercially until the end of the 19th century. This soft, silver-white metal was first used in paint pigments and as a substitute for tin in World War I. Today, about three-fourths of cadmium is used as an electrode component in alkaline batteries, with the remainder used in pigments, coatings, and plating and as a stabilizer for plastics. The primary and most serious adverse health effects of long-term exposure to cadmium include kidney dysfunction, lung cancer, and prostate cancer. Cadmium may cause local skin or eye irritation and can affect long-term health if inhaled or ingested. Cadmium make the part of food chain of fish and these fishes after using by human beings makes cause of some dangerous diseases.[14]

### Zinc

Zinc as an essential trace element with wide public health and clinical significance has been reviewed by FAO/WHO (2002).[15] The wide distribution of zinc in all body tissues and fluids reflects its essential role in metabolic activity as a component of key cell enzymes. The body's total zinc content ranges from about 1.5 g in women to 2.5 g in men. Skeletal muscle accounts for approximately 60 percent of the total body content and bone mass for approximately 30 percent. Plasma zinc has a rapid turnover rate and it represents only about 0.l percent of total body zinc content. This level appears to be under close homeostatic control. High concentrations of zinc are found in the choroid of the eye 274 µg/g and in prostatic fluids 300-500 mg/l.[16]


© Copyright protected. Unauthorised republication, reproduction, distribution, dissemination and copying of this document in whole or in part is strictly prohibited.

### Copper

The general population is exposed to copper through inhalation, consumption of food and water, and dermal contact with air, water, and soil that contains copper. The primary source of copper intake is the diet; however, the amount of copper in the diet usually does not exceed the average dietary requirements (RDAs) for copper. Drinking water is the primary source of excess copper. Populations living near sources of copper emissions, such as copper smelters and refineries and workers in these and other industries may also be exposed to high levels of copper in dust by inhalation.[17]

### Nickel

Nickel is widely used in industry and is a common aquatic pollutant. In natural waters Ni2+ is the dominant chemical species. In aquatic ecosystems nickel inter- acts with numerous inorganic and organic compounds and occurs as soluble salts adsorbed onto substances of different chemical origin. Some of these interactions are additive or synergistic in producing adverse effects, and some are antagonistic.[18]

### Lead

Lead is a chemical element in the carbon group with symbol Pb and atomic number 82. Lead is a soft and malleable metal, which is regarded as a heavy metal and another metal. Lead is a highly poisonous metal (regardless if inhaled or swallowed), affecting almost every organ and system in the body. The main target for lead toxicity is the nervous system, both in adults and children.

### Shnebaye Stream

It is a fresh water stream present in Handai karak in the east of Karak city. This stream started from the Handai karak and ends in the small village Charpara karak the local people of this area use the water of this stream for their daily need. This fresh water stream is present in the hilly area and high range of hills around the stream is present.

There are total five different fish species are present in the Shnebaye stream but the fish Barilius bendelisis is present in large numbers due to which the local people of this area called this stream is the home of Barilius bendelisis. The depth of the stream is from 3 to 4 feet and contains stones and small pebbles in their bottom and fishes present in this stream use these stones as a shelter. The fresh water stream Shnebaye also contains different microscopic plants in which spirogyra is very important because it is used as a food component.

## MATERIALS AND METHODS

### Study Area

The study was carried out during November to December 2013. The samples of fish, soil, plant and water were collected from Shnebaye Stream in Handai district karak Khyber Pakhtunkhwa. The people of this area use the water of this stream in their daily life. This area also represents a good site of journey and entertainment.

### Sampling Location

Fish, Plant, Soil, Water samples, were collected in between November and December 2013 from various stations (region of inlet, middle and outlet water flow in Shnebaye Stream in Karak region).The fish species Barilius bendelisis were collected from Shnebaye river in district karak with the help of hand net and cast nets in between November and December 2013. The collected fish samples were packed in plastic container and transported to the department of chemistry Kohat University (KUST), Kohat for further studies. The samples were collected in sterile polythene bags and kept in the laboratory deep freezer (-20°C) to prevent deterioration till further analysis.

### Sample Preparation

We worked on Dry method and prepared sample of fish organs viz. head, tail and abdomen. A clean washed high quality corrosion resistant stainless knife was used to cut the fish into head, tail and abdomen. About 2g dried homogenized fish samples were weighed accurately in an iodine flask separately; the samples were placed in incubator for 2 hour to become ash.

They were cooled in 10ml of concentrated HNO3 was added into each China dish and non porous Crucible. The samples in China dish and non porous Crucible were heated on a hot plate for half an hour to evaporate excess amount of $HNO_3$ and the solution was evaporated again on a hot plate, continuing until sample was completely digested and become colorless. The fluid was cooled to room temperature. The digested sample was filtered through Whatman filter paper no. 42 into 25 ml Graduated cylinder and made up to the volume using HPLC grade water.

## RESULTS

The collection of *Barilius bendelisis* fish, In which we detect the heavy metals in the fish body (head, abdomen and tail) and water sample (surface water, middle water, and startup water) plant Spirogyra and in soil. Results are shown by the graphical representation of the following tables.

**Table 1:** Heavy metal concentration (mg/L) in the three body regions (head, tail, and abdomen) of *Barilius Bendelisis* collected from shnebaye stream in district karak (mean value ± standard

| Heavy metals | Head | Abdomen | Tail |
|---|---|---|---|
| Ni | 0.777±0.027 | 0.743±0.007 | 0.781±0.050 |
| Cu | 0.551±0.037 | 0.551±0.011 | 0.592±0.029 |
| Zn | ND | 0.740±0.000 | ND |
| Pb | ND | ND | ND |
| Cd | 0.863±0.054 | 0.775±0.024 | 0.445±0.028 |


© Copyright protected. Unauthorised republication, reproduction, distribution, dissemination and copying of this document in whole or in part is strictly prohibited.

Figure 1 represents the level of five selected heavy metals (Ni Cu, Zn,Pb and Cd) in the fish species of Shnebaye Stream, in which the Cadmium have the highest level in all metals in the Head of (*Barillus bendalsis).* The recorded level of the values of all heavy metals in head, abdomen and tail of in(*Barillus bendalsis)*are: In Head region Cd>Ni>Cu, in Abdomen Cd>Cu & Ni>Zn and in Tail region Ni>Cu>Cd, *in* (*Barillus bendalsis)* respectively.

**Table 2**: Heavy metal concentration (mg/L) in Sample of water (surface, middle, start up), collected from shnebaye in district karak (mean value ± standard deviation).

| Heavy metals | Surface | Middle | Start up |
|---|---|---|---|
| Ni | 0.788±0.022 | 0.806±0.017 | 0.850±0.064 |
| Cu | 0.472±0.029 | 0.460±0.022 | 0.437±0.028 |
| Zn | 0.025±0.002 | 0.053±0.002 | 0.016±0.001 |
| Pb | ND | ND | ND |
| Cd | 0.403±0.029 | 0.355±0.044 | 0.229±0.113 |

**Table 3:** Heavy metal concentration (mg/L) in sample of plant (spirogyra) and soil collected from shnebaye in district karak (mean value ± standard deviation).

| Heavy metals | Spirogyra | Soil |
|---|---|---|
| Ni | 0.769±0.004 | 0.784±0.046 |
| Cu | 0.560±0.047 | 0.568±0.016 |
| Zn | 0.472±0.003 | 0.155±0.003 |
| Pb | ND | ND |
| Cd | 1.508±0.007 | 1.494±0.012 |

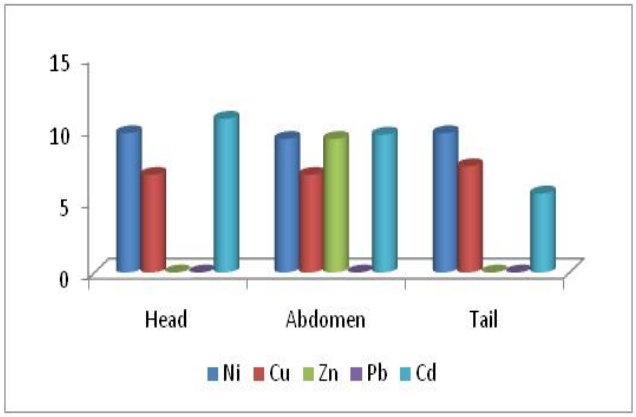


**Figure 1:** Concentration of heavy metals in fish sample selected from Shnebaye stream Karak.

Figure 2 represents the level of five selected heavy metals (Ni, Cu, Zn, Pb and Cd) in the Water of Shnebaye Stream Karak in which the Nickel have the highest level in all metals in the surface, Middle, and Startup water. The recorded level of the values of all heavy metals in Surface, Middle and Startup are Ni>Cu>Cd>Zn and Ni>Cu>Cd>Znand Ni>Cu>Cd>Zn respectively.

Figure 3 represents the level of five selected heavy metals (Ni, Cu, Zn,Pb and Cd) in the plant (Spirogyra) and Soil of Shnebaye Stream Karak in which the Cadmium have the highest level in all metals in the plant and soil. The recorded level of the values of all heavy metals in plant (spirogyra) and soil are Cd>Ni>Cu>Zn and Cd>Ni>Cu>Zn respectively.

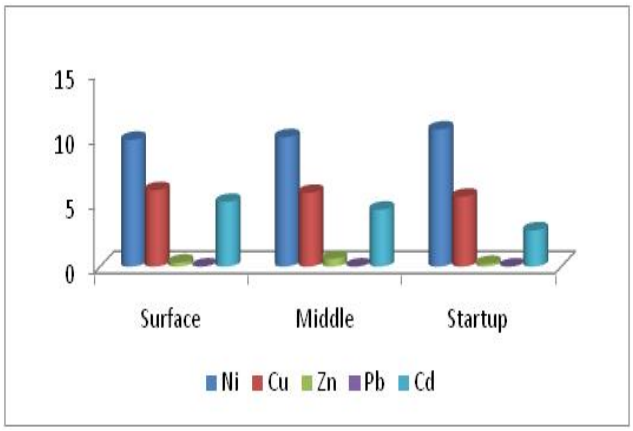


**Figure 2:** Concentration of heavy metals in Water sample selected from Shnebaye Stream Karak

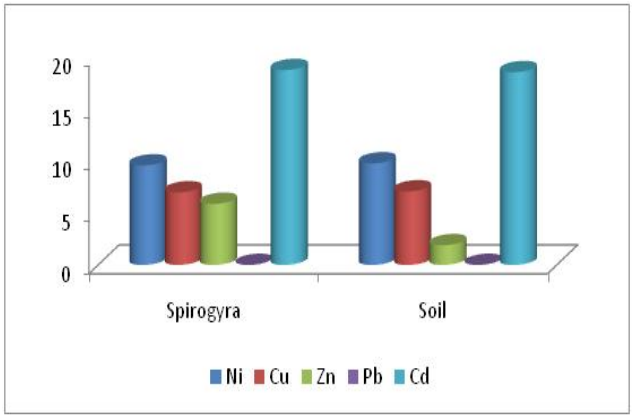


**Figure 3:** Concentration of heavy metals in plant (Spirogyra) and Soil selected from Shnebaye Stream Karak.

## DISCUSSION

Samples of *Barilius bendelisis* fish collection was carried out of Shnebaye Stream Karak during November to December 2013 for the Heavy metals detection. For this research we collected 10 Samples of *Barilius bendelisis* fish, for heavy metals detection.

Knowledge of heavy metal concentrations in fish is important with respect to nature of management and human consumption of fish. In the present study, the fishes at Shnebaye Stream Karak showed higher accumulation of Cadmium in their abdomen than other four metals in the head of fish (*Barilius Bendelisis*) at Shnebaye Stream.

While in the tail showed higher accumulation of Nickel in their bodies than other four metals in the tail of fish (*Barilius Bendelisis*) Shnebaye Stream.

While in the water sample collected from Shnebaye Stream karak showed highest accumulation of Nickel in the water. Nickel is widely used in industry and is a common aquatic pollutant. In natural waters Ni2+ is the


© Copyright protected. Unauthorised republication, reproduction, distribution, dissemination and copying of this document in whole or in part is strictly prohibited.

dominant chemical species. In aquatic ecosystems nickel inter- acts with numerous inorganic and organic compounds and occurs as soluble salts adsorbed onto substances of different chemical origin. Some of these interactions are additive or synergistic in producing adverse effects, and some are antagonistic.

While in the plant (spirogyra) and soil show higher accumulation of Cadmium then other four metals present in plant (spirogyra) and soil. Cadmium, a naturally occurring element found in the earth's crust, was discovered in 1817, but was not used commercially until the end of the 19th century. This soft, silver-white metal was first used in paint pigments and as a substitute for tin in World War I. Today, about three-fourths of cadmium is used as an electrode component in alkaline batteries, with the remainder used in pigments, coatings, and plating and as a stabilizer for plastics. The primary and most serious adverse health effects of long- term exposure to cadmium include kidney dysfunction, lung cancer, and prostate cancer. Cadmium may cause local skin or eye irritation and can affect long-term health if inhaled or ingested. Cadmium make the part of food chain of fish and these fishes after using by human beings makes cause of some dangerous diseases.

**Acknowledgment:** Thanks to all those who take part with me in this effort and make me possible to do this especially staff members of Kohat University of Science and Technology. I would like to thanks local peoples of the study area who helped me in collection of fish, plant, water and soil of shnebaye and shearing such valuable information.

## REFERENCES

1. JO Duruibe, MOC Ogwuegbu, JN Egwurugwu, "Heavy Metal Pollution and Human Biotoxic Effects", International Journal of Physical Sciences, 2(5), 2007, 112-118.
2. M Soylak, S Saracoglu, Elci M. Dogan, "Determination of trace amounts of some metal ions after separation/preconcentration with calmagite on Amberlite XAD-1180 by atomic absorption spectrometry", Int. J. En viron.Anal. Chem, Press, 2002.
3. SS Vutukuru, "Acute effects of Hexavalent chromium on survival, oxygen consumption, hematological parameters and some biochemical profiles of the Indian Major carp, Labeorohita", Int. J. Environ. Res. Public Health, 2(3), 2005, 456-462.
4. D Velez, R Montoro, "Arsenic speciation in manufactured seafood products" A review, J. Food protects, 61, 1948, 1240-1245.
5. HNA Muhammad, HHA Hossam, "Accumulation and distribution of copper and zinc in both water and some water tissues of two fish species (*Tilapia zillii and Mugilcephalus*) of lake Qarun, Fayoum Province, Egypt", Pak. J. Biol.Sci, 10, 2007, 2106-2122.
6. EO Farombi, OA Adelowo, YR Ajimoko, "Biomarkers of oxidative stress and heavy metals levels as indicators of environmental pollution in African catfish (*Clariasgariepinus)* from Ogun River, Int. J. Environ. Res. Public Health, 4(2), 2007, 158-165.
7. MZ Vosyliene, A Jankaite, "Effect of heavy metal model mixture on rainbow trout biological parameters", Ekologija, 4, 2006, 12-17.
8. HR Athar, M Ashraf, "Photosynthesis under drought stress. *Handbook of Photosynthesis*, Ed: M. Pessarakli, CRC Press, Taylor and Francis Group, NY, 2005, 793-804.
9. M Javed, "Heavy metal contamination of freshwater fish and bed sediments in the River Ravistretch and related tributaries", Pak. J. Biol. Sci, 8, 2005, 1337-1341.
10. FG Olaifa, AK Olaifa, TE Onwude, "Lethal and sublethal effects of copper to the African Cat fish (*Clariasgariepnus*)", Afr. J. Biomed. Res, 7, 2004, 65-70.
11. MU Etesin, NU Benson, "Cadmium, Copper, Lead and zinc tissue Levels in Bonga Shad (*EthmalosaFimbriata*) and Tilapia (*Tilapia Guineensis*) Caught from Imo River, Nigeria", Am. J. Foodtechnol., 2(1), 2007, 48-54.
12. DJ Ferner, "Toxicity, Heavy Metals", E. Med. J, 2(5), 2001, 1.
13. JS Boyer, "Plant productivity and environment potential for increasing crop plant productivity, genotypic selection", Science, 218, 1982, 443-448.
14. T Sorahan, "Mortality from lung cancer among a cohort of nickel cadmium battery workers", Br J Ind Med, 44, 1946–84, 803–809.
15. ST Teoh, "Recommended daily dietary intakes for Peninsular Malaysia", Med JMal, 30, 1975, 38-42.
16. JK Dunnick, MR Elwell, AE Radovsky, JM Benson, FF Hahn, KJ Nikula, EB Barr, CH Hobbs, "Comparative carcinogenic effects of nickel sub Sulfide, nickel oxide, or nickel sulfate hexahydrate chronic exposures in the lung", Cancer Research, 55(22), 1995, 525-526.
17. VS Shrivastava *et al*., "Study for Determination of Heavy Metals in Fish Species", Advances in Applied Science Research, 2(2), 2011, 161-166.
18. Waqar Ashraf, "The levels of Selected Heavy Metals in Tuna Fish", Arabian Journal for Science and Engineering", 31, 2006, 89-92.

**Source of Support:** Nil, **Conflict of Interest:** None.


© Copyright protected. Unauthorised republication, reproduction, distribution, dissemination and copying of this document in whole or in part is strictly prohibited.