Toxicity of heavy metals in water, sediments and different body organs of fish *Labeo rohita* (rohu) at head Balloki, river Ravi, Lahore Pakistan

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Abstract

The present work was designed to evaluate the Contamination of heavy metals in water is regarded as global crises with a large share in developing countries like Pakistan. In present study, health risk consequences of composition of heavy metal contaminated water and fish collected at Head Balloki (River Ravi) were evaluated. 3 samples of water were collected at six different sights of Head Balloki for each Pre and Post Monsoon. Fish samples were collected at some six sights and their gills, liver were removed for heavy metal analysis. This study reported that the Concentration of chromium Cr was found higher than the Nickel Ni in water Cr > Ni. On the other hand, in fish organ of *Labeo rohita* the concentration of Chromium Cr was higher than the Ni in Gills Cr > Ni and the concentration of Ni was higher than the chromium Cr in Liver Ni > Cr. All the samples were analyzed to determine the concentration of two heavy metals (Cr, Ni) using Spectrophotometer techniques. The data thus obtained were analyzed, statistically. Research must also analyze the relationship between water and heavy metals and metal levels detected in fish.

Introduction

Labeo rohita (Rohu) are among three financially significant fishes present in the streams of Pakistan. Keeping in see all realities study was focused on the particular fish type named *Labeo rohita* (Rohu) at two distinct waterways head one is the River Ravi. *Labeo rohita* is famous as a nourishment fish and a significant aquaculture freshwater species. Fish, as human nourishment, are considered as a decent wellspring of protein, polyunsaturated unsaturated fats (especially omega-3 unsaturated fats), calcium, zinc (Zn), and iron. Because of the lower cost and higher nutritive worth, it is one of the most significant sources among the nourishment results of creature birthplace. In future, fish will be an imperative wellspring of nourishment protein and the wellbeing for human utilization of items from aquaculture is of general wellbeing interest. Fish assume significant job in consolidating the poisonous quality of substantial metals which have an extraordinary biological hugeness because of their aggregate conduct and lethality.

Environmental pollution caused by heavy metals has aroused widespread concern around the world (Cui et al., 2011). The metal pollution of aquatic ecosystem is increasing due to the effects from urbanization and industrialization (Zhang et al., 2011; Grigoratos et al., 2014; Martin et al., 2015). The increasing pollution by heavy metals have a significant adverse health effects on invertebrates, fish and humans (Yi et al., 2011; Islam et al., 2014, 2015b, d; Ahmed et al., 2015). Freshwater ecosystems accumulate the impacts of human activities and consequently the quality of fish habitat depends to a large extent upon the density of the human population and its activities within the basin (Zalewski and Welcome, 2001). Heavy metals may exert beneficial or harmful effects on plant, animal and human life, depending on their concentrations. These metals are introduced into the environment through various routes, such as transportation vehicles, corrosion of underground pipes, smelting processes, fuel combustion, industrialization and municipal wastes.

Pollution of aquatic ecosystems is alarming in Pakistan and represents a fastest growing problem. Industrial activities have the ability of elevating the natural concentrations of heavy metals in recent times, causing serious environmental challenge and present everywhere in environment (Tabinda *et al.,* 2013; Akaahan *et al.,* 2015) especially in Pakistan.

Heavy metal contamination in aquatic environment is of critical concern because of their toxicity and accumulation in aquatic organisms (Oronsaye *et al.,* 2002*).* Fishes constitute major components of most aquatic habitats and they act as bio-indicator of heavy metal levels in aquatic environment (Tabinda *et al*., 2013; Akhwan *et al*., 2016). Naturally, heavy metals tend to accumulate in soils and sediments after weathering processes and can be deposited in water bodies during surface runoffs. When the heavy metals get into the aquatic ecosystem they usually scatter among the various compounds in the water (Anim-Gyampo *et al*., 2013; Akaahan *et al*., 2015). The effect of heavy metal on fresh water ecosystem has become global concern. The problem of water pollution by trace metal is known to be critical all over the world and especially in a developing country, where everybody is facing the problem of water pollution due to modern industrialization and civilization (Akintujoye *et al*., 2013; Ghorade., 2013; Krishna *et al*., 2014; Akaahan *et al*., 2015&2016).

Industrial development in Pakistan during past few decades has launched many industrial zones at major cities (Tabinda *et al*., 2013). These industries are producing tremendous amount of effluents that are drained into nearby rivers like Ravi (Tabinda *et al*., 2013). The hazardous and untreated effluents going into the river Ravi from Lahore (second largest city of Pakistan) has been estimated up to 729 tons per day. According to another estimate, about 1308 tons of untreated solid waste is going into Ravi on daily basis (Yasar *et al.,* 2010; Shakir & Qazi, 2013; Shakir *et al*., 2014).

Pakistan is also among one of those countries where industrialization grew rapidly during the past few years. Domestic, agriculture and industries are different source of pollution among which industries are discharging lot of toxic and hazardous waste water into rivers and exhibit a chronic toxic effects on aquatic life and ultimately on human’s life once it entered into the food chain. (Ullah *et al*., 2016).

River Ravi (Latitude: 30°22'40"N Longitude: 73°51'58"E) is on the waterway Sutlej in the Punjab area of Pakistan. Stream Ravi is one of the most sullied waterways in Pakistan that get a large number of gallons of profluent every day.

The current study was therefore planned to evaluate the heavy metal toxicity in water, sediments and different body organs of *Labeo rohita* (Rohu) collected at different places of Head Balloki, River Ravi.

Among a wide range of toxic substances that contaminate fish and seafood, two heavy metals; cadmium (Cd) and lead (Pb),) are the only heavy metals included in the European Union regulations for hazardous metals. Heavy metals can interfere with biological systems and have inappropriate interactions with different intracellular structures. They are highly toxic to marine organisms and human, even at very low concentrations due to bioaccumulation. Jinadasa *et al.,* 2013

The objective of this study was to obtain the concentration of different heavy metals in different body organs of *Labeo rohita* including gills, kidney,liver. Therefore, the current inspection was arranged while paying attention to the natural problems of the Ravi River to consider the impact of heavy metal pollution

Methods

Sampling procedure. The current study was planned to investigate heavy metal's bioaccumulation (Cd, Cr, Ni and Pb) in Water, Sediments and Fish *Labeo rohita* commonly known as Rohu collected at Balloki Head works at Ravi river at an expanse of about forty-two miles from Lahore in the inclination of South West (Atlas, 2002; Tabinda *et al.,* 2013

Water surface. Three samples of were gathered using Van Dorn Bottle Sampler from examining site with 6 repeats named as R, L, CT, BSL and C (Right Downstream, Left Downstream, Center of Headwork, Balloki, waterway and control, separately.Water tests were gathered from various profundities.Very nearly 200 ml of head site water for each example was separated by glass fiber channel of the scope of 0.45 µm (Akaahan *et al.,* 2015) and moved and safeguarded to poly propylene bottle with a size scope of 250 ml cleaned with water and afterward utilized concentrated nitric corrosive to fermented the example to pH <2.0 (Radhakarishnan, 2010).

Sediments. Three examples of Sediment were gathered and protected in zip lock polyethylene packs ice all through transportation to the examination research facility from the destinations in a day. Zip lock sacks were named with date, time and examining station for overwhelming metal investigation. Duplicated Sediment tests about 50g were gathered from the two destinations at left and right peripheral bunds. The residue tests were then air-dried and passed by a strainer of 1 mm in size that isolated the leaves, stones and dead spineless creatures. (Tabinda *et al.,* 2013).

Fish. Also, three examples of *Labeo rohita (rohu)* from locales of inspecting for pre and post-storm season) were peaceful from the Headworks of Balloki through arbitrary business finds during pre-rainstorm and post rainstorm season. Not long after assortment, the examples were shipped to the research center for additional investigation. Each example of fish was analyzed to gather liver, kidney, gills and muscle tests. All the choose organs will be exclusively gauged and afterward washed with ultrapure water and broke on a decent quality channel paper. The overwhelming metals fixation like Ni, Cr, Pb and Cd were dictated by utilizing spectroscopic strategies. (Tabinda *et al.,* 2013

Statistical analysis. T-test and ANOVA was applied using SPSS version 18/ Minitab version 16 USA software. The effect of these factors were declared highly significant if $P < 0.001$ very and significant

if P<0.05. Tukey Test was used for comparing metal concentrations among sampling sites on rivers and a p-value of 0.05 was considered for statistical significance.

Results

The current study was planned to investigate heavy metal's bioaccumulation (Cd, Cr, Ni and Pb) in Water, Sediments and Fish *Labeo rohita* commonly known as Rohu collected at Balloki Head works at River Ravi at an expanse of about forty-two miles from Lahore in the inclination of South West. Three samples of water, sediments and *Labeo rohita* were collected at upstream and downstream of left and right marginal bunds from the site (Head Balloki) for the study.

Concentration of heavy metals in water samples. The mean concentration ± S.D of Cd, Cr, Ni, Pb in water samples collected at River Ravi Head Balloki during post and pre-monsoon is presented in Table 1. Higher concentration of all the metals are observed in pre-monsoon as compared to post-monsoon season. Among all, the concentration of Lead Pb, was found the highest in both post (0.387 ± 0.05) and pre-monsoon (0.557 ± 0.68) seasons.

Concentration of heavy metals in sediment samples. The mean concentration ± S.D of Cd, Cr, Ni, Pb in sediment samples collected at River Ravi Head Balloki during post and pre-monsoon is presented in Table 2. Among all, the concentration of Chromium Cr, was found the highest in both post (4.54±0.5) and pre-monsoon (5.38±0.21) seasons. Table 2.

Concentration of heavy metals in meat samples. The mean concentration ± S.D of Cd, Cr, Ni, Pb in sediment samples collected at River Ravi Head Balloki during post and pre-monsoon is presented in Table 3. Among all, the concentration of Chromium Cr, was found the highest in both post (0.303±0.162) and pre-monsoon (0.595±0.206) seasons. Table 3.

Concentration of heavy metals in different body organs. Average Concentration of heavy metals in sediment samples collected at Head Balloki during Post and pre-monsoon (mg/L). The mean concentration ± S.D of Cd, Cr, Ni, Pb in Gills Samples collected at River Ravi Head Balloki during post and pre-monsoon is presented in Table 3. Among all, the concentration of Chromium Cr, was found the highest in both post 2.59±0.002 and pre-monsoon 2.74±0.298 seasons. Table 4.

The mean concentration ± S.D of Cd, Cr, Ni, Pb in Liver samples collected at River Ravi Head Balloki during post and pre-monsoon is presented in Table 5 among all, the concentration of Chromium Cd, was found the highest in post moon soon 2.94±0.368 and pre-monsoon Nickle Ni, was found the highest 3.95±0.467. The mean concentration ± S.D of Cd, Cr, Ni, Pb in kidney samples collected at River Ravi Head Balloki during post and pre-monsoon is presented in Table 6. Among all, the concentration of Nickel,was found the highest in post (2.61±0.41) and pre-monsoon (3.66±0.37) seasons.

Discussion

Labeo rohita (rohu) are three commercially important fishes present in the rivers of Pakistan. Keeping in view all facts study was targeted on the specific fish type named *Labeo rohita* at two different rivers head one is the River Ravi. *Labeo rohita* is notable as a food fish and a noteworthy aqua-farming freshwater species. Fish, as human food, are considered as a conventional wellspring of protein, polyunsaturated unsaturated fats (particularly omega-3 unsaturated fats), calcium, zinc (Zn), and iron. In view of the lower cost and higher nutritive worth, it is one of the most noteworthy sources among the food

In future, fish will be an urgent wellspring of food protein and the prosperity for human use of things from aquaculture is of general prosperity intrigue. Profound metals are a critical wellspring of food contaminating and prosperity peril. Fish expect noteworthy part in social affair the destructiveness of robust metals which have a mind boggling organic significance in light of their consolidated lead and noxiousness (Ali *et al.,* 2013).

These no biodegradable and nonessential heavy metals are highly toxic pollutants and their uptake and bioaccumulation in aquatic ecosystems, especially beyond acceptable limits, may cause serious consequences directly in the food chain and eventually for human beings (Rauf and Javed, 2007). The mean concentrations of Cd, Cr, Ni and Pb in water.

The convergence of iron in water of stream Ravi at Balloki Headwords during winter season was 7.4 events higher yet during summer 10.3 events in bounty than the WHO standard of 0.2 mg/L. Zinc obsession during winter and summer seasons was inside the EPA sensible standard of 3.0 mg/L. Likewise, copper obsession during both the seasons was well underneath the WHO uttermost compasses of 2.0 mg/L. Nevertheless, chromium regard was 7.0 events higher during winter season while 13.6 events in bounty during summer season when diverged from EPA standard of 0.010 mg/L. Nickel center during winter was twice while during summer 3.8 events higher than WHO cutoff of 0.020 mg/L. Relationship of metals centers distinguished during present assessments and their characteristics found recorded as a hard copy for various streams is presented in Table I. Extent of nickel in water of stream Ravi at Balloki Head works found during present assessments during both winter and summer seasons was extraordinarily low than its value uncovered by Rauf *et al,.* (2009).

In sediment metals fixations during summer season were higher when contrasted with winter season. Rauf *et al.,* (2009) announced comparable outcomes. Zinc fixation in dregs during winter was inside the Dutch admissible cutoff and in summer practically like the Dutch furthest reaches of 140µg/g. Copper focus in dregs was about 1.2 occasions higher during winter and 1.6 occasions in overabundance when contrasted with the Dutch norm of 36µg/g. The chromium and nickel focus in residue during both winter

and summer seasons was inside the Dutch reasonable restrictions of 100µg/g and 35µg/g individually. Dregs gather the metals from water so high measures of metals were recorded in residue when contrasted with water and fish tissue (Ullah, 2007).

Declarations

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.Author contributions

Author contributions KZR. and ZE made substantial contributions to study conception and design and to the drafting and critical revision of the manuscript. KZR. and DH contributed to data interpretation, and review and editing of the manuscript. All authors read and approved the final manuscript unanimously.

Conflicts of Interest

The authors declare no conflict of interest.

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Ethics approval and consent to participate. The research protocol was approved by the ethics committee or review committee of the Punjab fishery department at Lahore.

Consent for publication.

All authors agree to publish this work after departmental approval committee.

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Tables

Table1. Average Concentration of heavy metals in water samples collected at Head Balloki during post and pre-monsoon (mg/L)

Season		**Heavy Metals**		
	Cd	Cr	Ni	Pb
(Postmonson)	0.007±0.006	0.067±0.025	0.00	0.387±0.05

(Premonsoon)	0.227 ±0.084	0.526±0.178	0.257±0.04	0.557±0.068

Table 2. Average Concentration of heavy metals in sediment samples collected at Head Balloki during post and pre-monsoon (mg/L)

Season	**Heavy Metals**		
Cd	Cr	Ni	Pb
0.00	4.54±0.50	0.00	0.00
(Postmonsoon)			
(Pre monsoon)	0.60±0.21	5.38±0.21	0.537±0.125	0.387±0.107

Season	Heavy Metals			
	Cd	Cr	Ni	Pb
(Postmonsoon)	0.013±0.006	0.184±0.08	0.00	0.303±0.162
(Premonsoon)	0.595±0.206	0.547±0.127	0.022±0.007	0.52±0.154

Table 3. Average Concentration of heavy metals in meat samples collected at Head Balloki during post and pre-monsoon (mg/kg)

Table 4. Average Concentration of heavy metals in gills samples collected at Head Balloki during post and pre-monsoon (mg/kg)

Season	**Heavy Metals**			
	Cd	Cr	Ni	Pb
(Postmonsoon)	1.85±0.149	2.59±0.002	1.995±0.265	1.88±0.265
(Pre monsoon)	2.42±0.103	2.74±0.298	1.814±0.270	2.194±0.215

Table 5. Average Concentration of heavy metals in liver samples collected at Head Balloki during post and pre-monsoon (mg/kg)

Season	Heavy Metals			
	Cd	Cr	Pb	Ni
(Postmonsoon)				
	2.94±0.368	2.887±0.300	2.85±0.169	2.75±0.261
(Pre monsoon)	3.78±0.524	3.54±0.232	3.95±0.467	3.76±0.203

Table 6. Average Concentration of heavy metals in kidney samples collected at Head Balloki during post and pre-monsoon (mg/kg)

Season	Heavy Metals			
	Cd	Cr	Pb	Ni
(Post monsoon)	2.24±0.102	2.51±0.09	2.61±0.41	2.492±0.349
(Pre monsoon)	3.19±0.300	3.144±0.141	3.66±0.37	3.47±0.343

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