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The Assesment of Heavy Metal Toxicity in Tungabhadra River Fishes Labeo Rohita and Catla Catla.

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KEYWORDS

Fish, Heavy metals, Tungabhadra river, Toxicity, Human health.

ABSTRACT: Pollution effecting the natural aquatic environment due to heavy population, and increase industrialization in Kurnool . Humans take fish meal as a nutritional dietary uptake without the awareness of heavy metal from the polluted water bodies . The present research focused to quantify the heavy metals concentration in river water and a common edible fishes of Tungabhadra river areas in Kurnool. The manuscript examined the Heavy metals, which include Arsenic (As), Cadmium (Cd), Copper (Cu), Lead (Pb), Iron (Fe), Manganese (Mn), Mercury (Hg), Zinc (Zn) as persistent river water pollutants can pose significant Health risks to human and Kurnool aquatic ecosystems. For this study we have chosen the fish species are Indian carps Labeo rohita and Catla catla as bioindicators for the heavy metal contamination in the river water. The study observed the levels of metals varied among the gills and liver tissue of the fish samples. The metal concentrations found in fish gill and liver tissues were comparatively higher than the World Health Organisation regulations.

Introduction Heavy metal pollution of fresh water ecosystem occurring due to regular discharge of waste materials, Mining activities, agro toxic chemicals is globally arising concern and possesses a risky threatening to the human health due to their regular feeding habits.

Tungabhadra river forming a natural boundary for Kurnool city, Andhra Pradesh, India .It serves as major freshwater source and cultural importance symbol to the Kurnool area. Environmental threat to Tungabhadra river in Kurnool is resulted in accumulation of heavy metals which causes more severe problem to the aquatic animals(ATSDR(2011). The non-biodegradable nature of these pollutants affecting the long biological half-lives. In recent decades it is a big challenge to the ecosystem . Heavy metals usage in Cement and Carbide factories of Kurnool has led to over release of hazardious chemical substances into Tungabhadra river ecosystems(Baharom,Z.Y.2015).). Kurnool area is the major location for mining industries to the state of Andhra Pradesh. The impact of heavy metals on aquatic environments deteriorating the fresh water ecosystem which has become a globa concern. Heavy metal contamination of heavy metals in fresh water bodies badly affecting the public water supply system and fish consumers (Okunade,M.B.,Ogundele.2022).

In recent days after Covid-19 the common man was also very cautious about the nutritional food taking. In this regard people are showing much interest in consuming the fish in their daily menu as fish is the source of protein food. The quantity of heavy metal ions in fresh water organisms is more higher in present days. The process of heavy concentration and biological accumulation parlelly threatening the

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human health by consumption of fresh water fish (Pandey, GovindandMadhuri,2016) . In Andhra Pradesh Rivers are highly polluted because of discharge of industrial, municipal and agrochemical waste. River banks are being damaged due to uncontrolled sand diggining which reduce the flow of water that can severely impacts on the aquatic fauna. (C.Fernandes,M.A. Salgado (2008)). In this scenario consumption of river fish Tunga bhadra river area, Kurnool, Andhra Pradesh , India may lead to health related problems to local people and other consumers. This situation demands Control measures to reduce heavy metal pollution in the Kurnool Tungabhadra river (J.AlinnorandI.A.Obiji.(2010).

In India, fish is cheaply available to the common man and a major source of protein approximately42% , poly unsaturated fatty acids ,essential nutrients, Vitamins and required for healthy body (Kamal J. Elnabris (2013). The fish is also advisable to all kinds of patients by the doctors. Various species of fishes are abundantly available in streams of Tungabhadra rivers caught by the fisherman and they are sending to the local markets. The cheaply available fish are the one of the complementary protein sources to the common man in their daily diet .There are many studies showing significant effects of fish contamination with heavy metals. Some times continuous exposure of such fish meal can lead to serious health problems, like oxidative stress ,kidney damage and slow neurological function, particularly Manganese is related to IQ deficit in children and developmental issues in pregnant ladies. (N.C.Igwemmar1,S.A.Kolawole2, (2013). According to Ministry of agro industry and food security (MAIFSA) the major types of heavy metals found in Tungabhadra river fish are Lead, Arsenic, Chromium, Cadmium. These heavy metals in Tungabhadra river creating issues with human health, impact on environmental issues, bioaccumulation which greatly challenging the water regulation sectors. (Isangedighi, I. A. (2019). Long exposure of these heavy metals in non standard quantity can leads to carcinogenicity.

Consumption of fish in the human diet is safe at certain levels of priscribed guidelines These regulations were given by World Health Organization (WHO). According to WHO recommendation the heavy metals like mercury in fish body should be below 0.5 mg/kg. Diagnosis against WHO standards can helps in risk assessment of the human health.(WHO(1993). In addition to this the Indian Ministry of Agro-industry and Food Security (MAIFS) also participated in set up the Mauritian Food Act 1998 with the collaboration of WHO to identify the heavy metals concentration in aquatic foods . The low saturated fat and omega fatty acids in fish are helpful for building a good human health. The heavy metals once enter the fresh aquatic eco systems, they will gradually dissolved in the fresh water by osmosis and easily accumulate in the various parts of fish body.(FAO Fisheries and Aquaculture, (1999). If such fish are taken by the primary and secondary consumers they enter the food web of the ecosystem.(Garai, P., Banerjee, P., Mondal, P. (2021).

Scientific studies revealed that concentration of Lead is seen in elevated levels in Carnivorous whereas higher concentrations of Cadmium and Nickle, were found in omnivorous fish (Lackmann, C., Brendt.(2021). There is a positive correlation has observed with concentrations of Cd and Pb between fish tissues and fish weight is (p<1.06). The present study explained that fish Labeo rohita and Catla catla caught from Tungabhadra river in Kurnool were exposed with heavy metals at exceed levels(Pb, Ni ,Cd,.etc..). The Kurnool region is suitable for the river water aquaculture farming, as the City is surrounded by Tungabhadra river channels. recently industries like cement factories, polymer industries established in the Kurnool. These industrial activities spoiling the river bodies by releasing their waste products.. In this scientific investigation our team has collected the samples from different sites of Tungabhadra rivers which are adjacent to near by villages. A total of forty fish samples of Catla catla and Labeo rohita are collected at the sampling site. With the help of local fishermen we caught the fishes by using gill nets during the dry seasons. (Payus, C. M., Jikilim,.(2020).

In addition sediment pollution has the key potential for the entry of heavy metals by the supply of water, resulting in the contamination of water and soil. Later these metals may enter the wide range of habitats through food chain. Moreover, it should also be noted that heavy metals may enter the food chain directly or indirectly through the plasma membranes of aquatic animal sarcososes and gills. Which facilitates easy

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access to enter the food chain .A study observed that 45 % of the metal(Cd, Mn, Cu,) storage found in the muscles of fish heart, lungs, intestines, gills and liver. Heavy metals, microplastics, drainage from the industries and other pollutants can pose a severe threat which may leads to extinct of species from the aquatic ecosystem . (AOAC(2000).). Because of the high protein content and nutritional value fish is considered as an important part of the human diet for many decades). According to FAO in India people consume fish meal between four and six kilograms per year and it is increasing annually. In this scenario it has been argued that the fish collection from such a polluted water bodies is harmful to the human health. .

Hevy metals like Cd,Cr,Pb, can cause damage of DNA helical and pose carcinogenic effects to Kidneys, liver, lungs and other tissues .Pollution at Food, soil, air and, water can lead to accumulation of heavy metals (Yabe J, Ishizuka M, Umemura T (2010). In the year 2000 a new diagnosis technique named as toxic equivalent factor (TEF) has been introduced for identification of toxicity levels based on toxic equivalent factors . fresh water fish serve as a bio indicator of aquatic ecosystems. In Andhra Pradesh people consume the fishes often brought from the Bay of Bengal sea water and freshwaters. Among those many species of consumed fish have been reported to have heavy metal concentrations in them. In order to determine the negative impact on human health the concentrations of selected heavy metals (Pb, Cr, Cu, and Zn) in Catla catla and Labeo rohita fish are examined in this study. A distributional analysis undertaken as a bioindicator of Kurnool river areas that are contaminated with heavy metals based on this study. (Larsson, A.,Haux, C., 1985).

Sample Collection:

Our team collected the fish samples by using the gill nets and analysed according the APHA guidelines. The length and weight of the fish samples are measured by using scale and weighing machine. The samples were washed with distilled water and kept in the plastic tub and kept in the cool temperature at 4°C for further chemical analysis(AOAC(2000).OfficialMethodsofAnalysis).

The laboratory procedures in this study followed the guidelines of Analytical Methods for Atomic Absorption Spectroscopy.

A. Labeo rohita B.Catla catla

Before starting the chemical analysis the petridishes, glass jars applied with 10% (v/v) Nitric acid for 20hrs and cleaned with pure running tap water and kept under sunlight for drying. using steel knife we separated the gill and liver tissues as the test mainly focused on these sensitive tissues . After separation of the tissues they were placed in the 1: 3 ratios H2O2+HNO3 concentration mixture at 152°C for 30 minutes, later kept at the room temperature. duplicate samples were processed in and then the target tissues diluted to a total 60ml with ultra-pure water. Then the dilution was sieved through 0.45 µm micropore membrane filter paper. The filtrate kept separately in the glass jar for further chemical analysis. Our team has used the reagents were of analytical grade . All dilutions were made with ultra pure water. According to Perkin Elmer calibrations diluting stock solutions of mg/ml were prepared. Target muscle tissues (preferably from dorsal part) were separated by stainless steel knife and dried at 115°C in microwave oven. Based on the Analytical Methods wet digestion was used for Atomic Absorption Spectrometry. (Perkin Elmer.1996).

B. After completion of the drying process fish sample with 7 g weight was put into a 50 ml beaker with 7 ml of H_2SO_4 and 7 ml of HNO_3 until tissue sample stopped reacting with the chemical mixture. Later the tissue was then kept on a hot pan and heated at

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62°C for 35min. After the beaker was allowed to cool and 15 ml of HNO_3 was added and heated on the hot pan slowly upto the temperature reaches 150°C. at this level the samples in the beaker turned black colour. Later the sample was allowed to cool at room temperature. Then added H_2O_2 to observe the sample at visible clear. The sample taken in to a 100 ml volumetric flask and diluted with 75 ml pure water. The mixture was sieved and kept at laboratory room temperature for Atomic Absorption Spectrophotometer (AAS) analysis (Perkin Elmer.1996).

Heavymetal analysis

In this study by using Atomic absorption spectrophotometer(AAS) our team examined the heavy metals such as Heavy metals included are Copper (Cu), Arsenic (As), Cadmium (Cd), Mercury (Hg), Lead (Pb), Iron (Fe), Zinc (Zn), and Manganese (Mn). We have prepared a solution on Element standards by diluting the stock solutions of 110mg/ml of each element based on(Aderinola*etal*.,2011) . After dilution process the heavy metals concentrations data was noted in mg/kg, wet weight (WW) for Labeo rohita sample and for water in µg/L.

Results

HeavymetalconcentrationsofArsenic(As),Lead(Pb),Cadmium(Cd),Mercury(Hg),Iron(Fe),Manganese(Mn),Copper (Cu), Zinc (Zn) observed in Labeo rohita and Catla catla mentioned in (Table 1)collected from the Handri river coast of Kurnool town, Andhra Pradesh**.**

Table:

HeavymetalconcentrationsofArsenic(As),Lead(Pb),Cadmium(Cd),Mercury(Hg),Iron(Fe),Manganese(Mn),Copper (Cu), Zinc (Zn) observed in Labeo rohita and Catla catla mentioned in Table collected from the Tungabhadra river of Kurnool town, Andhra Pradesh**.** (All the values are mentioned in Microgrampergram)

Tungabhadra river area	**Labeo rohita**		**Catla catla**	
Nameof the metal	**Gills Muscle**	**Liver**	**Gills**	**Liver**
Copper (Cu)	1.61±0.70	29.13±.4.97	1.51±0.080	30.10±3.92
Arsenic (As)	0.060±0.04	0.059±0.02	0.054±0.14	0.061±0.11
Iron (Fe)	69.82±11.12	59.01±8.10	440.36±69.12	100±15.92
Cadmium (Cd)	0.05±0.006	0.07±0.006	0.09±0.013	0.08±0.002
Mercury(Hg)	0.07±0.013	0.05±0.006	0.06±0.015	0.629±0.17
Manganese(Mn)	5.36±1.08	5.86±2.03	6.09±0.93	6.04±1.11
Lead(Pb)	0.110±0.26	0.381±0.029	0.20±0.014	0.053±0.019
Zinc (Zn)	45.12±10.62	30.41±8.39	20.94±3.24	37.09±4.97

Heavy metal toxicity -DNA damage

DNA molecules may get damage by the accumulation in fish body .through various mechanisms including reactive Oxygen soecies(ROS) and sometimes hevy metals like Cr, Hg directly forms bonding with DNA helicals s and interfering processes. This toxicity is known as genotoxicity which may lead to mutations and chromosoma damage. By observing with single-cell gel electrophoresis (SCGE) method we can determine DNA damage in single cells including RBC of aquatic animals. (Tierney,K.B.,Baldwin,D et.al2010).

Ni: Industries uses Nickle for various activities. This is observed as a major pollutant of aquatic eco systems. Basically, in aquatic systems Ni form soluble salts by joining with other chemical ions which cause several negative effects. (Tchounwou PB, Yedjou CG, Patlolla AK, Sutton DJ (2012et.al) Based on the concentration

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of Ni , purity of water many studies revealed that respiratory functions will become complex when Ni accumulated in gills of fish. In addition, Ni was found to accumulate in the intestine of fish and disrupt the function of the intestine . heavy quantity of Ni damages the iron metabolism and alters the normal physiology . Some studies has been shown that Ni toxicity leads to oxidative stress in fish body and circulatory disorders (Yılmaz,F.,Özdemir,N.,et.al.2007).

Cr : It plays an important role in glucose metabolism. Cr compounds are high persistent in aquatic sediments. They are highly stable and forms as calcium chromate, Zinc chromates. Accumulation of these chromates are severe toxic and carcinogenic in nature.Exposure of Chromium compounds may result in the formation of ulcers, in intestinal tissue of aquatic animals. Over exposure of chromium compounds accumulates in fish body and can lead to inhibition of enzyme erythrocyte glutathione reductase. (**Saha R, Nandi R, et.al (2011)**).

Pb: Accumulation of Pb in fish body results in reproductive physiology such as poor quality in sperm and ovum, reduced fertilization and hatching rate, low survival of embryo and larvae, etc. (Goyer RA.1990).

Zn: toxicity damages the fish liver by increasing the activity of ALT and AST. Moreover,high Zn levels significantly reduce the body protein and lipids of fish, which might result in the oxidation of protein and lipids, as well as low protein intake. (Sehgal,R.,Saxena,A.B.et.al1986).

Cd:Effects of Cadmium (Cd) Long exposure of cadmium poses Cadmium shown high toxicity at even minute concentrations and has severe and chronic effects on fish body and ecosystem (Vesey, D.A. 2010).An increase in humoral immune responses are also observed at high concentration of Cd (Romeo,M.,BennanN.,2000) Significant histological alterations such as , necrosis in Liver and pancreatic tissue and lipid changes in the hepatocytes, peripancreatic cells swelling of blood vessels observed (Yamawaki,K.,Hashimoto. 1986). In all animal species Heavy Cd mainly targets Kidney and causes disturbance of calcium metabolism, hypercalciuria which can leads to formation of renal calculi. (Sivaperumal, P., Sankaret.al2007).

Effects of Iron (Fe) For a normal physiological and metabolic activities of organisms Fe in essential at optimal conditions. but it may be harmful to aquatic organisms at higher concentrations. **.** **(**Alkan,N.,Alkan, A.,Gedik,K.,Fisher,A.et.al2016) observed that at more than 1.1 mg/l iron concentrations badly affects the respiration, filter feeding of juveniles and caused reduced growth,prolonged stress, morphological change ,decrease in feeding rate and reduced growth occured in Labeo rohita and Catla catla.

Discussion

The non biodegradable metal ions causing aquatic pollution. Globally in recent decades it is one of the biggest problems and also affects the total aquaculture sector in Andhra Pradesh as well in India. These heavy metals enter the Fish body and creating health risks to consumers like human being. (M. Sarkar,J.B.Islam (2016).When the Fishes are exposed waterborne metals with high concentration level can leads to bio-accumulation through their gills, or by drinking polluted water. This phenomenon increases the metal concentration levels in muscle and other body parts of the fish Labeo rohita . We found high level metal accumulation in the gills and liver which are the active site of metabolic activities of Labeo rohita**.** Under homeostatic conditions Manganese may not be harmful to the aquatic fauna and flora, but it is hazardious to the human body of it is exceeded the necessary concentrations. **(**Okunade,M.B.,Ogundele,et.al.(2022).

Table 1 shows that the heavy metals observed in fish species Labeo rohita and Catla catla collected at Tungabhadra river water, Kurnool, the heavy metal concentrations Arsenic(As)0.060, Lead(Pb)0.053, Cadmium(Cd) 0.07, Mercury(Hg) are more than permissible levels. Iron(Fe)69.82, Zinc(Zn)45.12 were observed in high concentrations, whereas in Calta catla fish values from Tungabhadra river are Lead (Pb) 0.053±0.019, Arsenic(As) 0.061±0.11, Cadmium (Cd), 0.09±0.013, Mercury (Hg) 0.629±0.17, Zinc (Zn) 37.09±4.97, Iron(Fe) 440.36±69.12 of metals concentrations in the gills are more than permissible levels in gills and liver of the fish. Some metals like ions are important for the regular fish metabolism ,but non-essential metals accumulate in different organs of fish body. (Emmanuel, A.T. Oyeniyi, A. T.et.al (2020).

Humans consume the musculature portion of the fish body, hence many studies have observed how the

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accumulation of heavy metals occur (Mavura WJ, Wangila PT. et .al(2003)), if the fish body got contaminated with toxic chemical substances , it causes negative impact on human health such as kidney diseases, cardiovascular problems, demineralization of bone, infertility and neurological health risks etc… Animal body contains a few amount of metals like zinc, mercury, copper etc. These metallic oins are very much important in physiological functioning of the body. If the animal body accumulated with more quantity of these metals, they will damage the vital organs such as liver, brain, Heart etc..we can find the symptoms like Abdominal pain, dehydration, Diarrhea, nausea, numbness. Sometimes heavy metal poisoning shows severe symptoms like memory loss, Anemia, kidney damage, breathing alterations, developing of Cancer risk.

In recent decades the heavy metals causing health problems in humans and other animals. due to their toxicity the health risks includes reproductive, neurological, and digestive problems. (Sonone,S.S., Jadhav (2020). these metals are also responsible for causing severe toxic pollution in our surrounding aquatic environment. At different ecological circumstances like temperature,ph, pressure ,age, growth rate ,need of food, oxygen levels in the water, the fish may uptake the heavy metals.

The present analysis on heavy metals in the Tungabhadr river water are beyond the WHO guidelines. (Pb) > chromium (Cr) > zinc (Zn) > cadmium (Cd) > mercury (Hg) > arsenic (As)). Based on the result values of present study clearly revealed that fishes can be used as bioindicators for Tungabhadra river water pollution.

Conclusion

Fish species show differential susceptibility to heavy metal which can greatly affect fish species by growth alteration, failure in reproduction, histological damage, Therefore, the contamination sources for heavy metal in the aquatic bodies must be regulated, because it will be hazardous to the animals by consuming fish from Tungabhadra river area, Kurnool. The study observed significant changes in the water quality. By monitoring heavy metal levels regularly in the nearby river bodies helpful for public helath. To eliminate this problem from the ecosystem river health management should be strictly implemented by the local government with the help of NGOs and other Social service organizations. A high number of people consume fish regularly, posing a health risk as a result, but addressing this issue is a matter that is extremely important to society today. By solving this problem, it will be possible to prevent a number of diseases, such as those harmful to the population of fish.

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Conflict of interest

Authors declared that there is no conflict of interest.

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