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Accumulation and Histopathological Effect of different Tissue in the Fresh Water Fish *Catla catla*

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Abstract: ***Heavy metals are matters that form most dangerous effect in the aquatic animals of chemical water pollution due to the accumulation of some heavy metals and cannot be eliminated from the body by metabolic activities. In this study literature is examine the characteristics and general sources, uptake by fish concentration evaluation and effect on fish and other aquatic organism of heavy metal such as Cadmium, Chromium, Copper, Zinc, Lead ,Nikhil, Dolerite . Studies examined showed that Heavy metal cause severe damage on fish thus endangers fish health and ecosystem and respectable risks for human via consumption of heavy metal contaminated fish.***

Keywords: Heavy metal, Effect, Accumulation chirimiri

1. Introduction

Metals are incouuptible and are considered as major environmental pollutants causing cytotoxic mutagenic and other carcinogenic effect in animals. Aquatic organism has the ability to accumulate heavy metals from the water sources. Therefore accumulation of heavy metal in aquatic organisms can pose a long lasting reaction on biological, biochemical cycle in the environment. Heavy metal can also adversely affect the growth rate in the major carp fishes are often at the top of aquatic food chain and may concentrate large amount some metal from the water metal accumulation is largely attributed to differences in uptake and deportation period for various metal in different fish species, multiple factor including season physical and chemical properties of water can play a major role in metal cumulation in different tissue. (ATSD 2003) The gills are directly contact with water. Therefore the concentration of metal in gills reflects their concentration in water where the fish lives whereas the concentration in liver and muscles, gonads represent storage of metals in the water.

The study carried out on fish revealed that all heavy metals despite the fact that some of them are essential for life have adverse effect on living organism through metabolic interference and mutagenesis.(Abadi et al;2014) These adverse effects are decrease in fitness interference in reproduction that lead to cancer (Carcinoma) and eventually death. In addition to reproduction hypoxic conditions, excessive, stocking heavy metal effects also cause stress in fish. Stress factor also including pollution affect growth, development and reproduction adversely by changing metabolic, physiological and biochemical function. Adverse impact and physiological function and biochemical parameter in blood and tissue of the fish living in metal contaminated waters have been observed. (Balami et al;2019) It has been reported that fish exposed to metals showed immune system main function and thus become vulnerable to contagious diseases and had a greater mortality risk.

In despite of carcinogenic effect of heavy metals are not know well, several studies suggested geotaxis effects may exist. Heavy metals enhance clastogenic either directly or indirectly by inducing toxicity of other chemical agent. Heavy metals exposure reduces estrogenic and androgenic secretion and also cause pathological changes in fish.

2. Material and Method

Study site

Chirimiri is the most densely forest, rural and tribal zone in the Koriya district of Chhattisgarh state. The region is rich in natural recourses several coal mines, several ores and minerals for sample collection water of dam get down near the water and to test the water sample of the Laboratory of Dr. C.V. Raman university.

Figure 1: Location of Sarbhoka and Morga dam in Chirimiri

3. Collection Data and water sample

Water sample are collected monthly from different sampling areas of dam water sample were analysis from the sampling points during the study period June 2020 to May 2021. And second session June 2021 to May 2022. The water quality parameters such as water temperature were measured with the help of mercury thermometer. Ph level of the water is studied with the help of ph meter, conductivity DO,TDS, transparency, alkalinity and dissolved oxygen was test with the help of analyzer and photo spectrometer. Water sample was collected in 1 L polyethylene bottle from selected station and brought to the laboratory. 2-3 ml of concentration HNO3, was added to the sample in order to make pH 2.1, so that no microbial growth takes place and also prevent water from any degradation (APHA 1998)

The sample thus collected was kept in refrigerator (4'C) prior analysis through, AAS. No scrutiny of water sample was done. During the present study of investigation the quality of water, of two different station viz. Sarbhoka and Morga was evaluated in terms of physic- chemical heavy metals in water. A live fish (15±1g) were collected from sarbhoka Dam and morga Dam Nagpur Chirimiri Chhattisgarh India. The fishes were maintained in non-chlorinated water in 15 day. The ground nut, fish meal and rice bran, groundnut, soybean, were mixed and sterilized and mixed cadmium and chromium ,Zinc, Nickel Copper, Lead Dolerite (Cao) 1mg/L water in different concentrations (0.2ppm, 0.4ppm and 6.0ppm) for experimental fishes and without heavy metal and diet for control fish. In every 10 in days and their impact on tissue of fishes, histology of Gills, liver, kidney, gonads and histopathology, cytology of fishes was also undertaken.

Analysis of heavy metal by Atomic absorption Spectrophotometer

The metal concentrations were measured using a perkin Elmer AS 3100 flame atomic absorption spectrophotometer. Heavy metals concentration of Zn, Cr, Cd, Cu, Hg, Ni, Pb in the muscle ,gills, liver, kidney and gonads tissue sample of each fish were analyzed in triplet each season (Summer, winter and rainy). The result were present as µg metal/g wet weight. A range of standards for each metal was prepared from E. merck solution . Standard curve were prepared and the ODs obtained were calibrated again the standard curve to know the concentration of heavy metals present.

Dissection of different organs

Before dissection fish were properly washed with distilled water. Total fish length and weight were measured up to the nearest millimeter and gram Then dissection carried out on a clean working glass and out the desired organ/tissue. A weighed portion of Gills, muscle, liver kidney and gonads were separated with the help of a clean knife. The separated portion of each organ were placed in properly marked, sterilized polythene bags and stored in the freezer at (-25) till further analysis.

Scrutiny fragment of different organs of fish

Tissue of the know weight were cooled in a Petridis. The tissues were dried in an oven set at 90' C and were shifted to100 ml volumetric scrutiny flasks. Before the organ/tissue transfer all the flasks were washed with distilled water and dried in oven at 60'C for 25 minutes . Samples were scrutinized and due freez. As light modification was made in the procedure, adapted by Yousafzai and Shakoori 2006. Instead of putting 10 ml nitric acid 55% and 5 ml perchloric acid 70% at the time of scrutiny., 5 ml nitric acid 55% and 1 ml perchloric acid. 70% were added to the flask , were kept air tight for overnight. The next day a second dose of 5 ml nitric acid 55% and 4 ml (70%) perchlonic acid 70% was added to each flash were then placed on a hot plate and allowed to digest at 200-300 until a transparent and clear solution was obtained. The dense white smoke from the flasks after brown smoke were an indication of completion of the process of scrutiny.

In this method scrutiny was completed in about 30 minute instead of 3 hours as stated. After scrutiny samples were cooled and dilute to 10 ml with nano pure distilled water and stored stored in properly washed glass bottle until the metal concentration could be determined.

Statistical Analysis

Data obtained was analyzed and the result are expressed in mean ±S.D.

Table 1: Heavy metals concentration in different tissues of *Catla catla*
Season- Summer

Analyses of HM	Muscle (n = 10)	Gills (n = 10)	Liver (n = 10)	Kidney (n = 10)	Gonads	
					Ovary (n=10)	Testes (n=10)
Zn	1152.5 ± 240.6	971.1±102.7	2529.5±1730.9	1325.8±973.5	132.5±16.7	140.8±20.9
Ni	74.5±32.6	102.5±36.9	51.5±27.8	112.7+-97.8	17.9+-7.5	28.9±12.5
Cd	74.2±66.2	61.3±14.6	65.5±14.8	56.7±13.9	64.8±60.3	56.6±13.9
Cu	132.6±13.5	155.6±32.7	212.8±8.2	202.0±70.9	142±37.6	163.6±40.5
Pb	102.6±15.6	142.8±35.7	152.5±35.8	142.8±12	97.5±37.6	107.3±16.8
Cao	102.4±17.9	139.7±17.0	118.7±17.8	120.7±20.8	118.6±20.7	108.6±97.3
Cr	111.5±53.6	144.6±23.9	223.5±8.5	125.9±10.7	102.5±53.7	114.8±51.3

n= number of sample mean±S.D

Table 2: Heavy metals concentration in different tissues of *Catla catla*
Season – winter

Analyses of HM	Muscle (n = 10)	Gills (n = 10)	Liver (n = 10)	Kidney (n = 10)	Gonads (N=10)	
					Ovary (n=10)	Testes (n=10)
Zn	1102.5 ± 220.3	981.1±112.7	2764.5±1530.9	1102.6±933.5	112.5±13.7	130.8±16.9
Ni	61.5±28.2	102.5±26.9	121.5±93.8	122.7+-96.3	17.9+-7.5	29.9±13.5
Cd	64.2±46.2	63.3±16.6	63.5±12.8	65.7±14.9	77.8±61.3	58.6±11.9
Cu	122.6±10.5	157.6±22.7	215.8±6.2	212.0±72.9	142±37.3	153.6±30.5
Pb	92.5±10.3	124.8±31.7	122.5±31.8	152.8±10.0	91.5±35.5	117.3±13.8
Cao	398.4±15.6	123.7±15.4	238.7±15.8	125.7±22.8	112.6±22.5	118.6±95.3
Cr	101.5±55.6	124.6±21.5	213.5±16.5	135.9±12.5	122.5±56.5	104.8±52.3

n= number of sample mean±S.D

Table 3: Heavy metals concentration in different tissues of *Catla catla*
Season – Rainy

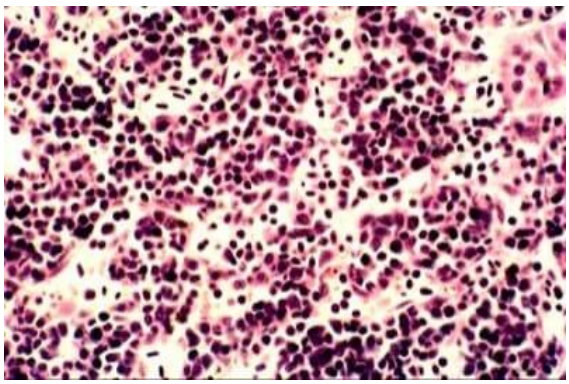
Analyses of HM	Muscle (n = 10)	Gills (n = 10)	Liver (n = 10)	Kidney (n = 10)	Gonads	
					Ovary (n=10)	Testes (n=10)
Zn	1252.5 ± 240.6	981.1±101.7	2529.5±1730.9	1325.8±973.5	132.5±16.7	120.8±20.9
Ni	74.5±32.6	102.5±36.9	111.5±97.8	112.7+-97.8	17.9+-7.5	28.9±12.5
Cd	72.2±60.2	158.3±14.6	65.5±14.8	56.7±13.9	76.8±60.3	56.6±13.9
Cu	132.6±13.5	155.6±32.7	212.8±8.2	202.0±70.9	142±37.6	130.6±20.5
Pb	102.6±15.6	132.8±35.7	92.5±35.8	102.8±12	57.5±37.6	67.3±16.8
Cao	305.4±20.9	539.7±17.0	418.7±17.8	220.7±20.8	354.6±20.7	218.6±97.3
Cr	101.5±53.6	144.6±23.9	223.5±8.5	125.9±10.7	102.5±53.7	114.8±51.3

n= number of sample mean ± S.D

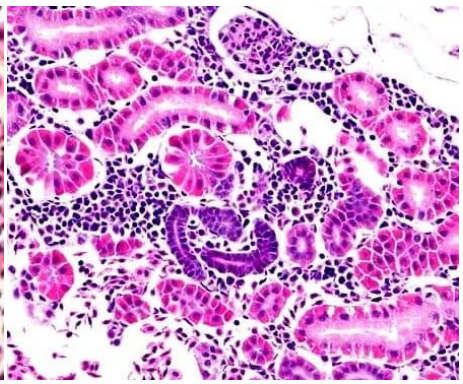
4. Observation and Result

The accumulation of **cadmium chromium and lead** in the gills tissue caused damage to it. The observation revealed impairment of respiratory and extra renal function of the gill due to hypertrophy and hyperplasia of intralammellar epithelium and separation of epithelial layer in the catla catla exposed to various Heavy metal. Structural impairment in the liver leading to the destruction of the hepatocytes was observed in Catla catla after zind, cadmium and copper poisning. Severe damage to the gills is notised in calta catla exposed to a number of heavy metals. Histological alterations were observed in the gill lamellae such as bulging at basal and distal parts of the lamellae,pypertrophy and hyperplasia of the lammeliar and intralammellar cells, separation of respiratory epithelial layer and atrophy and necrosis in *catla catla.(Naeem2021)* The dose of lethal and sub leathal concentration of **Zn, Cd, Cu,** and Mercury compound induced histopathological changes like hyperplasia, Severe hepatic dysfunction and edema in the liver of the *Catla catla*.

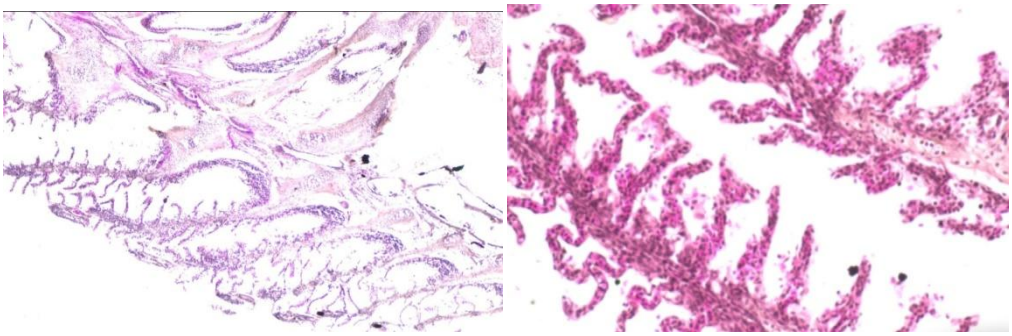
Histopathological effect of **nickel** are reported on the gills architecture of tropical freshwater fish noticed by hyper trophy of respiratory and mucus cells, necrosis and hyperplasia.(Yilmaz et al 2005) The liver histology of a fish treated lead revealed hydrophobic degenerative changes in the hepatocyte .



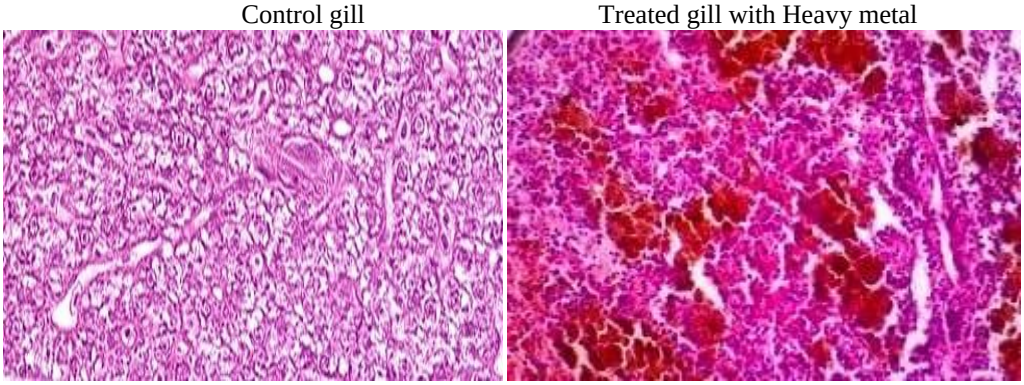
Control kidney



Heavy metal treated Kidney



Control gill Treated gill with Heavy metal



Control Liver Treated liver with Heavy metal

Lamellar hypertrophy and hyperplasia in the epithelium of the gill lamellae, necrosis in the intra hepatic pancreas and vacuolization in the hepato cytes, cellular integrity of intestinal mucosal epithelial cells were noticed in the fish on exposure to Cadmium, Chromium, Lead and Copper. Lifting of the secondary epithelium, curled secondary lamellae and chloride cell hypertrophy of the gill, vacuolation and nuclear pyknosis of liver and the degeneration of tubular epithelium cells with their capillaries of kidney were noticed in carp on exposure to various heavy metal.(J.Det al;2012) Several histopathological deformities were reported in the organ gills , liver kidney and gonads, of the *Catla catla*. Respiratory lamellar hyperplasia, edema and detachment of the gill, lipid vacuolization of entrecotes. Swelling, bile stagnation, focal necrosis and atrophy of liver were reported in the fish *Catla catla* exposed to acute and sub acute dose of heavy metal.

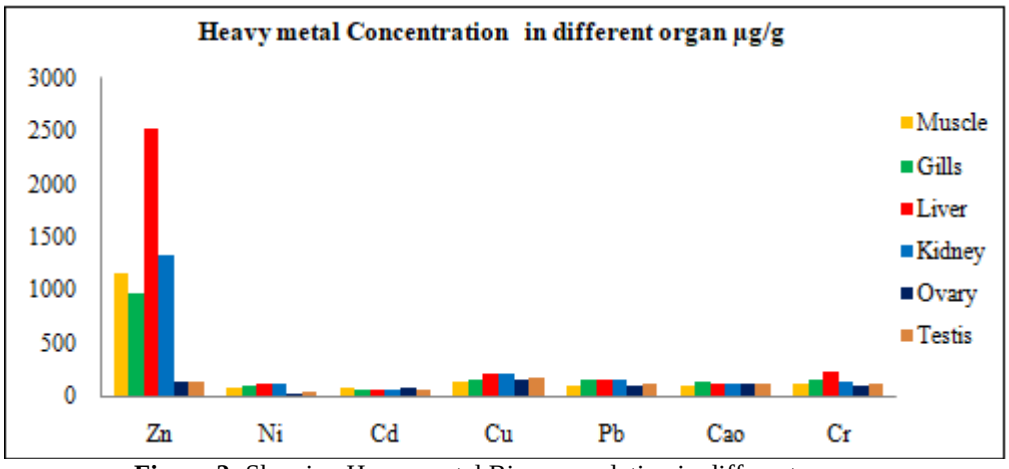


Figure 2: Showing Heavy metal Bioaccumulation in different organs

5. Discussion

The heavy metals including Zn, Ni, Cr, Cd, Cu, and Hg, Pb and dolerite was analysed in the different part of the body. In different season. Table i, ii and iii and figure ,show the accumulation of Heavy metals and their toxic affect in Liver, kidney, gills muscle and gonads. The Zn is mostly accumulated in every season by liver and kidney. The liver hepatic cell showing damage in slide. The sequence of metal accumulation in the liver of *catla catla.* Zn>Cr>Cu>Pb>Cao>Cd>Ni. The order of metal accumulation in different organ of the fish was Liver>Kidney>Muscle>Gills>Testis>Ovary. This fish highest accumulated heavy metal burden in Liver and least in ovary.

6. Conclusion

Fish absorb metals from aquatic recourses. The primary through gills surface are considered as the first target of heavy metals bioaccumulation. Gills surface consist of an epithelium membrane and negatively charged and thus

provides a potential site for gill metal interaction for positively charged metals. Liver and kidney play a major role in fish body (T.L.Guidotti et al; 2008) it's also play a vital role in accumulation and detoxification of Heavy metal. Exposure of fish to elevated level of heavy metals induces the synthesis of metallothioneine proteins which are metal binding proteins. This study show the highest concentration of heavy metals load of Zn in the liver and Kidney.

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