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DISTRIBUTION OF Fe, Pb, Cu, Cr AND Cd IN THE FLESH, GILLS AND LIVER OF FISH (*SYNODONTIS BATENSONDA*) SAMPLES FROM RIVER GALMA, ZARIA, NIGERIA

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ABSTRACT

Iron, lead, copper, chromium and cadmium concentrations were determined in the flesh, gills and liver of fish (Synodontis batesonda) samples collected at ten different points along River Galma in Zaria, Kaduna State using atomic absorption spectrophotometer (AAS). Except for the concentration of iron (Fe) in the liver, the concentrations of all the metals analysed in the three organs depict the pattern: gills > liver > flesh. The concentrations of these heavy metals in fish gills and liver is much higher than that in flesh. The profile mean metals concentration in the flesh is Fe > Pb> Cu > Cr > Cd, while in the gills and liver is Fe > Pb > Cr > Cu > Cd. Iron and lead are the most abundant elements in the fish samples studied. The concentrations of the metals in this study were lower than the maximum permissible limits of NESREA and WHO. Stringent measures need to be enforced by the authority on illicit discharge of industrial and domestic wastes into the river.

Keywords: River Galma, Heavy metals, Pollution, Bio accumulation, Pollutants, Effluent.

Contribution/ Originality

This Study will invariably aid in maintaining the fish species population of the river and sustain the employment status of the local fishermen by portraying the heavy metal concentrations of the fish that could lead to the reduction of biodiversity. Also, the control of this pollution in Galma River will guarantee abundant and readily available fish necessary for the essential protein needs of the local population and beyond.

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1. INTRODUCTION

In many parts of Nigeria, especially big and old cities, industries spring up at appreciable rates without proper environmental impact assessment (EIA) and environmental management and planning (EMP). Therefore, there is tendency of the industries to discharge pollutants into the various parts of the environment which include water bodies. The presence of any foreign substance in the water bodies (river, lake, sea etc.) tends to degrade the quality of the water and constitutes hazards to biota or impairs the usefulness of the water [1].

Indiscriminate discharge of pollutants especially heavy metals causes a lot of havoc in aquatic habitats which ranges from change in water quality and negative effects on physiological functions of aquatic biota among others [2, 3]. According to Dougherty, et al. [4] aquatic animals consumption such as fish remains a major route of pollutants especially heavy metal exposure to man. Accumulation of heavy metals in fish tissue depends on factors such as metal bioavailability, season and physicochemical properties of the water [5]. Bioaccumulation of metals refers to the amount of heavy metals ingested by an aquatic organism, distributed and retained among the various tissues [6]. Fish, being the commonest animal in the aquatic systems, has high economical value and serve as a good bio-indicator because of its potential to accumulate heavy metals and other organic pollutants [7, 8].

River Galma basin is a booming agricultural zone where various farm produce are cultivated on both sides of the river banks throughout the year. Fertilizers, herbicides and insecticides are commonly used and are eventually washed into the river via surface runoff. Petrol powered water pumps are used to irrigate the farmlands in the dry seasons which is a possible source of pollution in the river. Most of the industries located in Zaria town discharge their wastes directly into river Galma and its tributaries. Domestic sewage and refuse also find their way into the river from the many settlements along the river via leaching, direct discharge and surface runoff. This has the tendency of raising heavy metal content of rivers above natural loads and has become a problem of increasing concern worldwide [2]. According to Spiegel and Farmer [9] serious metal pollution could result from the discharge of unregulated effluents into natural freshwater bodies. The persistence, toxicity and bio accumulative nature of heavy metals make it an important pollutant in the environment [10]. This research is aimed at determination of the concentration of Fe, Pb, Cu, Cr and Cd in one of the common edible fish (*Synodontis batesonda*) in River Galma.

2. MATERIALS AND METHODS

2.1. Description of Sampling Site

River Galma is located in Zaria an ancient town in Kaduna State, Nigeria on latitude $11^0 3$'N and $7^0 40$'E. The river transcends across the industrial, agricultural and commercial areas of the town and is joined by many tributaries from far industrial, agricultural and domestic areas. The industrial discharges and the tributaries laden wastes constitute the bulk of pollution source to the river. According to Tariq, et al. [11] there is a global concern over the rate of deterioration of rivers with respect to heavy metal pollution. Heavy metals have high pollution potential in rivers which can be assessed using fish, sediments or water samples [12].

2.2. Sampling

Thirty adult fish samples, three each from ten sampling points were caught by a fisherman around the river bank. The fish samples were put in sterile polythene bags, labeled, put in icebox, and taken to the laboratory for pretreatment.

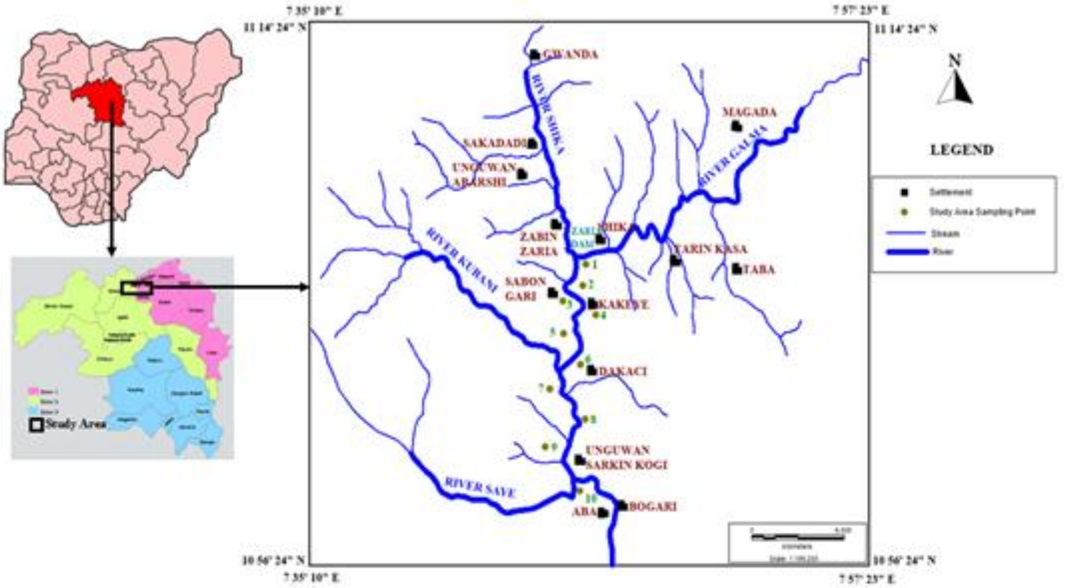

Fig-1. Showing Lay Out of River Galma Showing Sampling Points

2.3. Sample Preparation

The pretreated samples were allowed to thaw and washed with running tap water before dissection with sterile scissors to remove gills, liver, and flesh. The separated organs were placed in Petri dishes and dried at 105°C in an oven for three (3) days with intermittent weighing until a constant weight was obtained. The dried samples were grinded using mortar and pestle, sieved with 0.5mm sieve, stored in sample bottles and labeled [13].

2.4. Digestion of Sample

1.00g of the grinded pretreated sample was weighed and placed in a cleaned dried beaker. Then 10cm^3 of freshly prepared 1:1 mixture of concentrated HNO_3 /H_2O_2 solution was added and the beaker was covered with watch glass for initial reaction to subside. The beaker was then placed on water bath and boil at a temperature of 120^0 C for two hours to reduce the volume to 3cm^3.Then 20cm^{3}of distilled water was added and the solution was allowed to cool. The resultant mixture was filtered using Whatmann filter paper into a 50cm^3 volumetric flask, diluted to the mark with distilled water, transferred into a plastic sample bottle and labeled accordingly [14]. This was repeated for all the samples.

2.5. Determination of Heavy Metals

The digested samples were analysed for the various metals using Atomic Absorption Spectrophotometer(AAS).

3. RESULTS AND DISCUSSIONS

The result of the concentrations of Pb, Cr, Cd, Fe and Cu in the flesh, gills and liver of *Synodontis batensonda* in River Galma in presented in table 1.

Table-1. Concentrations of heavy (mg /Kg) in Flesh, Gills and Liver of Fish (Synodontis batesonda) sample from Galma water.

	Pb			Cr			Cd			Fe			Cu		
Sample. Points	**Flesh**	**Gills**	**Liver**	**Flesh**	**Gills**	**Liver**	**Flesh**	**Gills**	**Liver**	**Flesh**	**Gills**	**Liver**	**Flesh**	**Gills**	**Liver**
1	0.096	0.139	0.092	0.027	0.051	0.082	0.020	0.011	0.030	0.168	0.415	0.375	0.041	0.018	0.095
2	0.103	0.111	0.103	0.035	0.034	0.012	0.007	0.181	0.003	0.202	0.538	0.511	0.042	0.014	0.029
3	0.098	0.154	0.155	0.040	0.062	0.002	0.005	0.039	0.046	0.222	0.242	0.618	0.026	0.001	0.058
4	0.026	0.032	0.089	0.047	0.018	0.110	0.031	0.035	0.016	0.258	0.413	2.317	0.008	0.036	0.031
5	0.096	0.075	0.043	0.067	0.099	0.025	0.033	0.013	0.011	1.371	0.463	0.247	0.064	0.062	0.002
6	0.071	0.051	0.190	0.033	0.051	0.032	0.005	0.005	0.011	0.229	0.468	0.477	0.015	0.018	0.070
7	0.027	0.029	0.031	0.053	0.010	0.048	0.019	0.011	0.022	0.141	0.716	0.852	0.011	0.092	0.014
8	0.041	0.049	0.015	0.020	0.011	0.010	0.009	0.002	0.015	0.175	0.125	0.181	0.050	0.018	0.006
9	0.075	0.152	0.083	0.004	0.042	0.019	0.009	0.019	0.033	0.292	0.569	0.199	0.033	0.043	0.008
10	0.083	0.133	0.050	0.012	0.032	0.015	0.009	0.020	0.034	0.230	0.478	0.477	0.034	0.045	0.010
MEAN	0.072	0.093	0.084	0.034	0.041	0.036	0.015	0.034	0.022	0.329	0.443	0.625	0.032	0.035	0.032
SD	± 0.029	± 0.051	± 0.058	± 0.019	± 0.027	± 0.035	± 0.010	± 0.053	± 0.013	± 0.369	± 0.165	± 0.629	± 0.018	± 0.027	± 0.032
TOTAL CONC.	0.249			0.111			0.071			1.397			0.099		
NESREA LIMITS	0.2			-			0.2			-			20		
WHO LIMITS	0.5			-			0.5			-			30		

The average concentrations of the elements analysed in the various parts are Pb (flesh 0.072, gills 0.093, liver 0.084) mg/kg; Cr (flesh 0.034, gills 0.041, liver 0.036) mg/kg; Cd (flesh 0.015, gills 0.034, liver 0.022) mg/kg; Fe (flesh 0.329, gills 0.443, liver 0.625) mg/kg and Cu (flesh 0.032, gills 0.035, liver 0.032) mg/kg. Except for the iron concentration the concentrations of the elements in the flesh, gills and liver depict the pattern: gill > liver > flesh. This observation may be attributable to the facts that gill plays an important role in the interface between the ambient environment which may contain the analysed metals due to pollution and internal body of the fish. Gill is the respiratory organ of fish through which exchange of dissolved oxygen from the water body to the internal body of the fish takes place. This is achieved by allowing water to pass through the gills which may be the cause of high exposure of the gills to the dissolved metals in the ambient aquatic environment [15].

Generally the total concentration of the metals analysed in the samples depicts the pattern Fe > Pb > Cr > Cu > Cd. This pattern is in line with the natural distribution these metals in the earth crust. The results obtained for the total concentrations of these metals in the fish sample analysed are generally lower than the results reported by [16-21] and higher than results reported by Eletta, et al. [22] and conform with result reported by Tukura, et al. [23] the variations observed may be attributed to the level of pollution in the aquatic environment. The higher the concentrations of the elements in water body the more the concentration in the fish samples [24]. Except for Pb with total concentration of 0.249mg/kg which is slightly higher than the National Environmental Standard and Regulation Enforcement Agency (NESREA) limit of 0.2mg/kg. The total concentrations of all the elements in the fish samples are within the Federal Government of Nigeria NESREA Gazette [25] and WHO [26] limits.

The distribution of the Pb, Cr, Cd, Fe and Cu in the fish tissues at various sampling points are presented in figures 2A, 2B, 2C, 2D and 2E respectively.

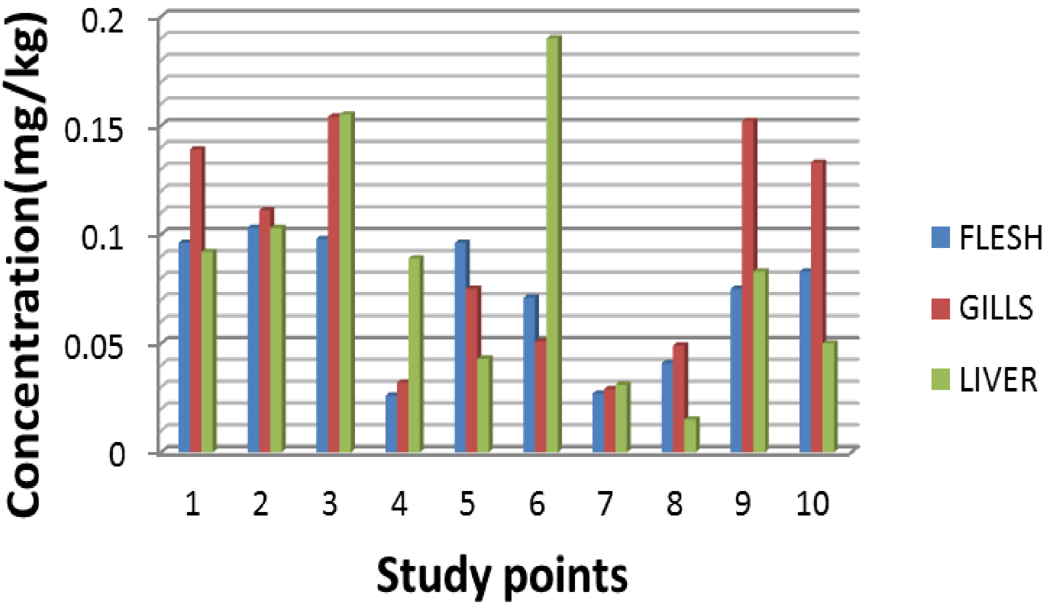

Figure-2A. Distribution of Lead in organs of synodontis batesonda from river Galma, Zaria

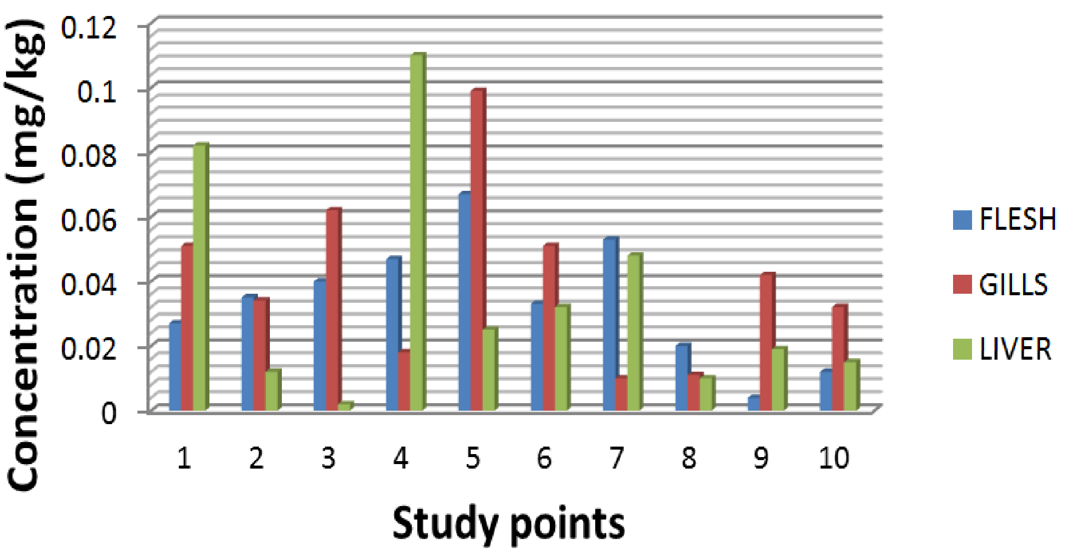

Figure-2B. Distribution of Chromium in organs of synodontis batesonda from river Galma, Zaria

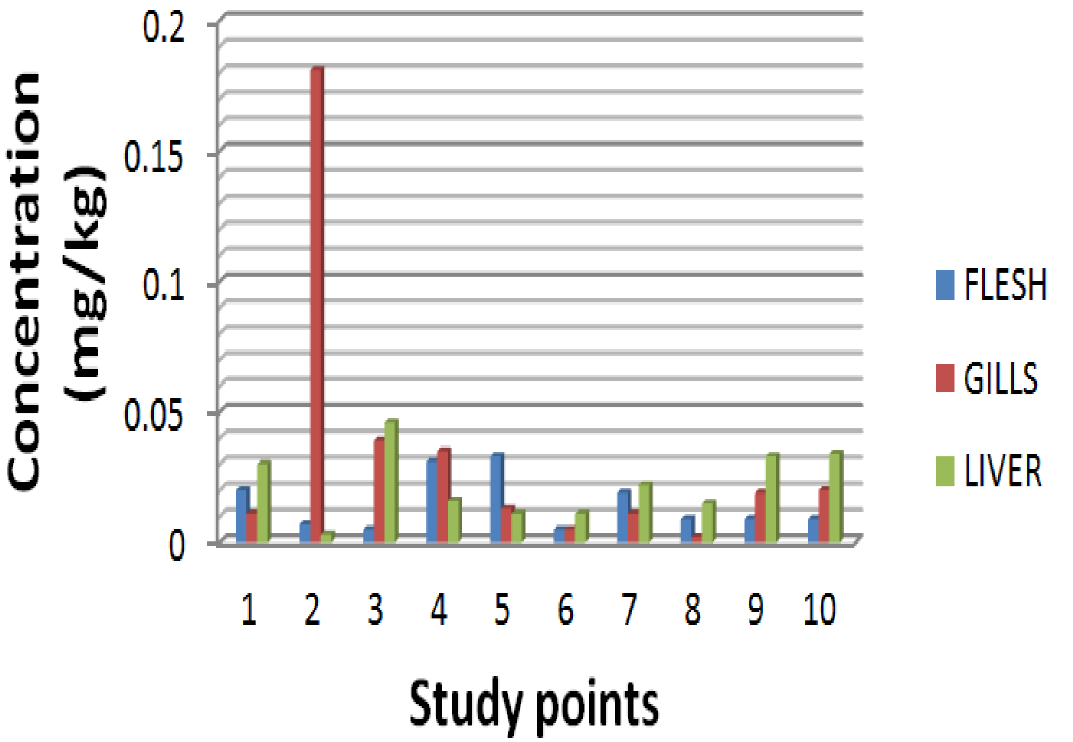

Figure-2C. Distribution of Cadmium in organs of synodontis batesonda from river Galma, Zaria

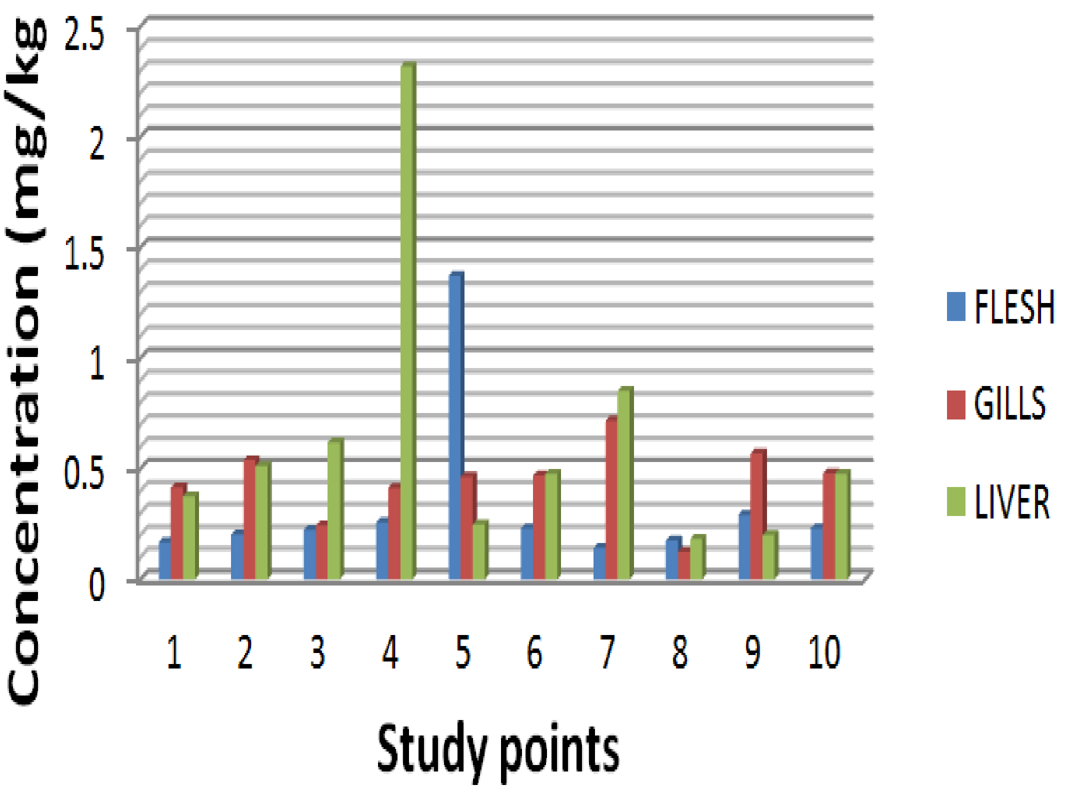

Figure-2D. Distribution of Iron in organs of synodontis batesonda from river Galma, Zaria

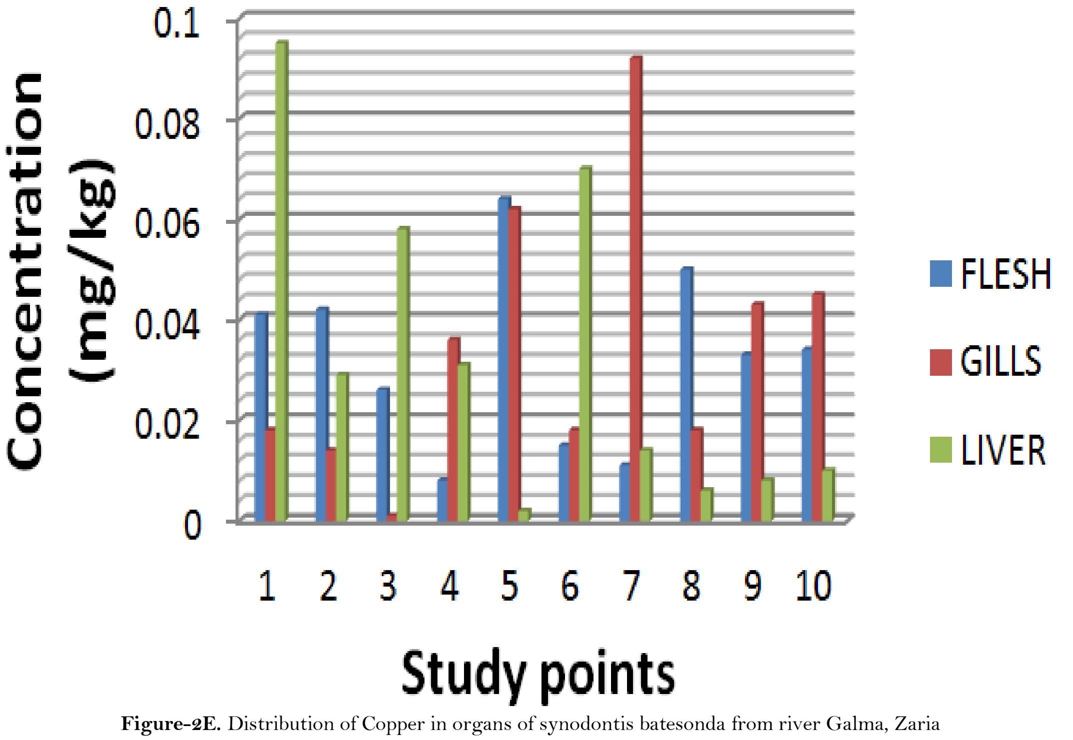

Figure-2E. Distribution of Copper in organs of synodontis batesonda from river Galma, Zaria

4. CONCLUSION

The distribution patterns of Pb, Cr, Cd, Fe and Cu in the three organs of fish depict the pattern gills > liver > flesh and the total metal concentrations in the fish samples are within the recommended limits set by NESREA and WHO.

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