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Bioaccumulation of heavy metals in fish collected from Ghailarh lake of Madhepura, Bihar

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ABSTRACT

This study was carried out to investigate some physico-chemical parameters and Lead, Zinc, Copper, and Chromium bioaccumulation of fishes' muscle collected from Ghailarh lake of Madhepura, Bihar. This study will provide information on the human consumption safety of these fish samples from the lake. Surface water, and fish samples from fisherman landing site respectively were collected bi-monthly. Water temperature, pH, and Dissolved Oxygen were measured *in situ*, while other parameters were determined according to APHA standard methods. All the measured physico-chemical parameters are within the recommended permissible limit for aquaculture. Copper recorded the 0.52-1.69 μg/g, Zinc 42.46-57.74 μg/g, Lead 0.68-1.6 μg/g, Chromium 0.42-0.98 μg/g in common carp, where as in Tilapia fish Copper recorded the 0.30-1.03 μg/g, Zinc 24.11-48.59 μg/g, Lead 0.48-1.016 μg/g, Chromium 0.45-0.90 μg/g. The mean concentrations of all the metals in the present study were lower than the permissible limits, thus the sampled fish from the lake are generally safe for human consumption.

Key Words - Physico-chemical parameters, Human consumption, Permissible limit, Ghailarh Lake

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INTRODUCTION

Due to their toxicity, extended time persistence, bioaccumulation, and bio-magnifications in the food chain, water contamination has long been identified as the primary hazard to the aquatic ecosystem (Morilla *et al.*,2004). Heavy metals are metallic elements with relatively high density and are dangerous or poisonous even at low concentrations. The term "heavy metals" can refer to any metallic element. Heavy metals can get into ecosystems from both natural and human sources, and once they do, they end up dispersed throughout the organs and tissues of living things. Even though some of these metals are required by live organisms in extremely minute quantities, in higher concentrations, they can become extremely harmful to the organisms' health (Ogbuagu *et al.*, 2011). Bioaccumulation in the tissues of organisms has been identified as an indirect measure of the abundance and availability of these metals in aquatic environments (Kucuksegin *et al*., 2006). The accumulation rate depends on the organism's ability to digest the metals and the concentration of such metals in the water body. Bioaccumulation measures the abundance and availability of these metals in aquatic environments. The bio accumulation rate is also contingent on the concentration of the metals in the sediments that are immediately adjacent to the organism, in addition to the feeding behaviours of the organism (Ishaq *et al*., 2011). Aquatic creatures can bioaccumulate substantial levels of trace metals, and these metals have the potential to persist in their tissues and organs for extended periods. Since living organisms cannot break down these metals and they remain in the environment indefinitely, they are harmful to the aquatic environment and, as a result, to people who rely on aquatic goods, such as fish, for their primary means of subsistence (Kakulu *et al*.,1988) Fishes are known to bio-accumulate metals. As a result, they can be used as bio-monitors. They also have the advantage of allowing the comparison of metal concentrations between sites, which is particularly useful in situations where water samples are either close to or below the detection limits of the atomic absorption technique. Not only is Ghailarh Lake used for agriculture, artisanal fishing, and recreational activities, but also, the hosting community and the surrounding industries channel their waste into the lake. Because of this, it is essential to assess the heavy metal concentration in the fish organs and fillets of the lake.

MATERIALS AND METHODS

All the water samples for temperature, Dissolved oxygen, electric conductivity, pH and turbidity were conducted as per APHA. The fish sample was collected from the landing centre of fisherman and analyzed for heavy metals as per APHA (2012).

RESULTS AND DISCUSSION

Table 1: Physico-chemical parameters of Ghailarh Lake (2019-20)

Month	Temp.	DO	pH	Turbidity	EC (µs cm^{-1})
October`19	27.10	4.85	8.46	42.78	129.73
November`19	26.43	5.25	8.68	50.74	120.59
December`19	26.13	3.53	8.78	38.50	109.28
January`20	26.83	6.17	7.55	7.20	117.37
February`20	28.20	3.27	8.01	6.40	104.53
March`20	28.90	4.70	6.55	6.13	124.97
April`20	29.50	6.30	6.31	12.20	117.03
May`20	29.93	1.87	7.28	55.00	125.67
June`20	30.37	4.22	8.80	65.24	115.10
July`20	28.47	6.71	7.72	122.67	95.43
August`20	28.03	7.34	7.70	114.47	101.47
September`20	27.60	5.57	7.69	96.33	108.67

Table 2: Physico-chemical parameters of Ghailarh Lake (2020-21)

Month	Temp.	DO	pH	Turbidity	EC (µs cm^{-1})
October`20	27.53	5.20	7.28	74.77	131.40
November`20	26.80	6.23	8.52	52.13	120.50
December`20	26.17	3.73	8.33	44.87	105.27
January`21	26.10	6.84	7.70	6.45	108.68
February`21	26.40	4.22	7.77	8.40	104.22
March`21	26.80	3.28	6.19	6.56	107.22
April`21	27.20	5.66	6.34	14.80	109.23
May`21	28.60	3.56	7.65	92.77	105.87
June`21	29.26	4.84	8.45	98.38	111.87
July`21	28.02	5.35	7.88	108.22	110.77
August`21	28.23	8.24	8.15	99.21	115.32
September`21	27.88	7.28	7.20	66.77	106.22

Table 3: Levels of heavy metals in Sediments and water of Ghailarh Lake

Source	Level	Conc. of Cu	Conc. of Cr	Conc. of Pb	Conc.of Zn
Water	Minimum	0.00-0.04	0.00-0.019	0.018-0.096	0.026-0.124
	Median	0.019	0.014	0.044	0.074
Sediment	Minimum	0.98-4.42	1.80-6.42	4.28 -8.42	10.48-20.44
	Median	2.26	3.76	5.98	14.40

Fig 1 : Concentration of Heavy metals in water in Gailarh lake of Madhepura

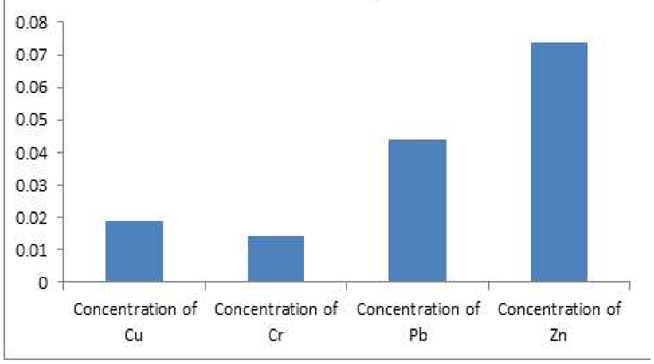


Fig 4 : Concentration of Chromium in muscles of Common carp fish collected from gailarkh lake of Madhepura

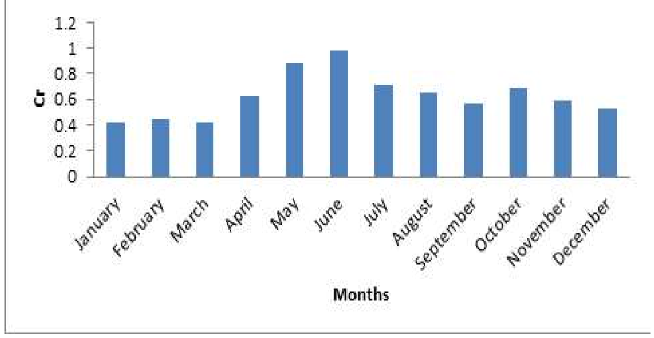


Fig 2 : Concentration of heavy metals in sediments in Gailarh lake of Madhepura

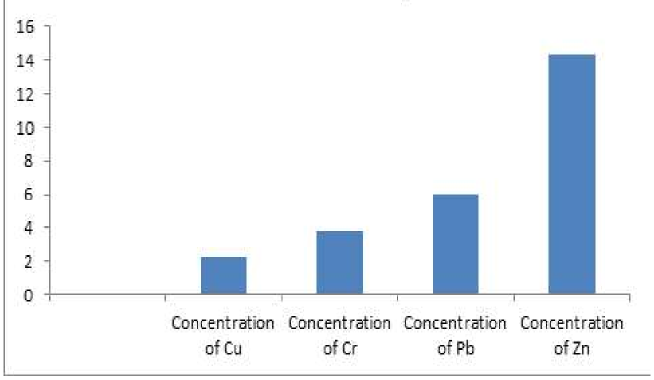


Fig 5 : Concentration of Lead in muscles of Common carp fish collected from Gailarkh lake of Madhepura

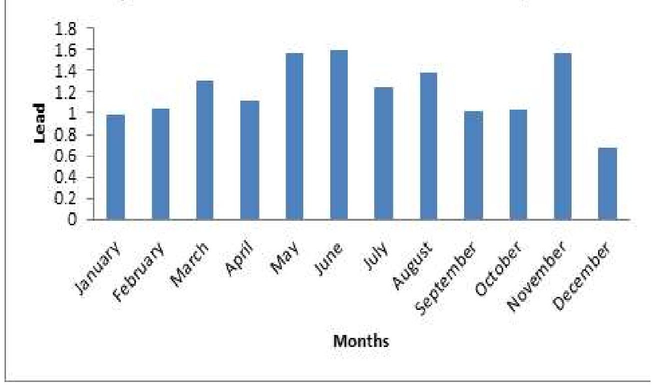


Fig 3 : Concentration of Chromium in muscles of tilapia fish collected from Ghailarh lake of Madhepura

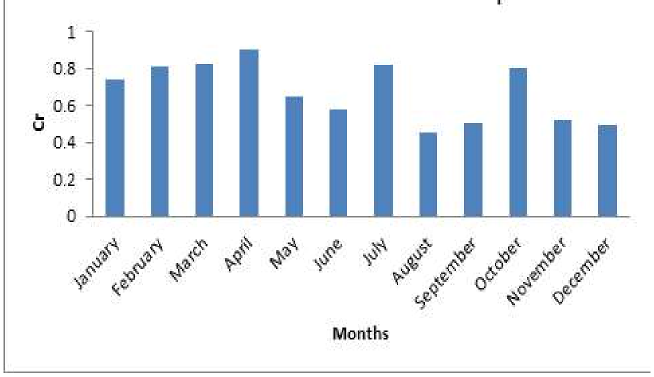


Fig 6 : Concentration of Lead in muscles of Tilapia fish collected from Gailarkh lake of Madhepura

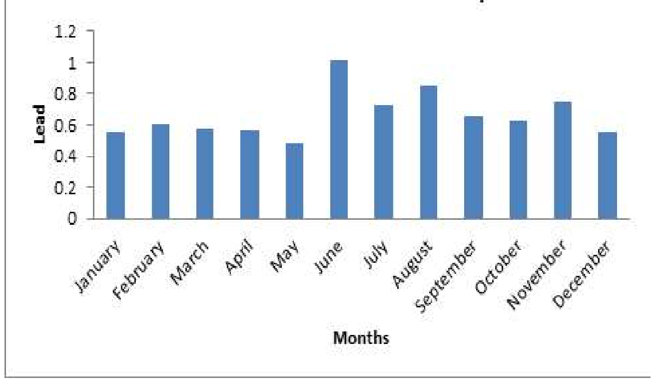


Fig 7: Concentration of Zinc in muscles of tilapia fish collected from Gailarkh lake of Madhepura

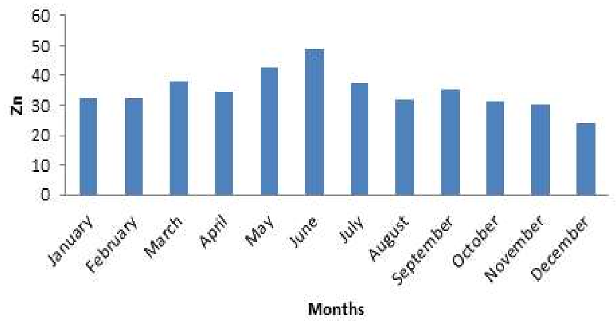


Fig 9: Concentration of Copper in muscles of Common carp fish collected from Gailarkh lake of Madhepura

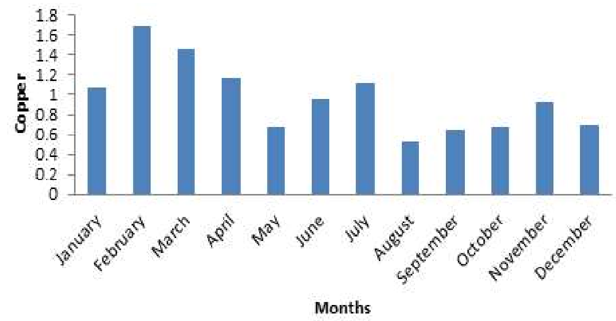


Fig 8: Concentration of Zinc in muscles of Common carp fish collected from Gailarkh lake of Madhepura

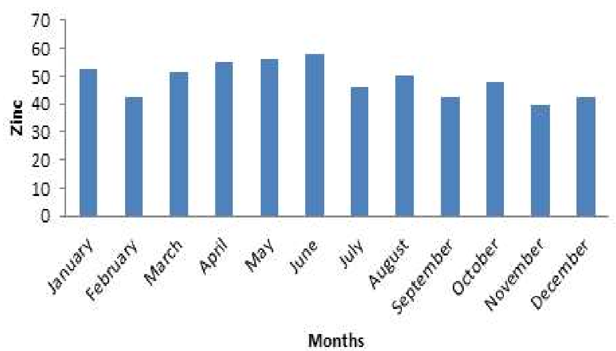
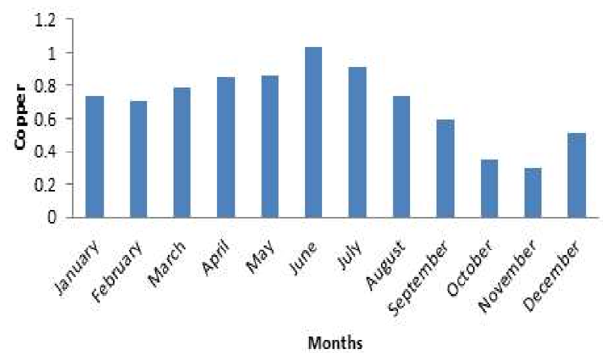


Fig 10: Concentration of Copper in muscles of Tilapia fish collected from Gailarkh lake of Madhepura



The observed significant variation in surface water temperature, dissolved oxygen current work may have affected the speed of one or more of the biochemical reactions, the metabolic rates of the organism, how pollutants interacted with the organism, and other materials in water, as also observed by Ogbuagu *et al.* (2015) and Akinrotimi *et al*. (2007). These variations may be related to patterns of water use, weather conditions, water depth, and run-off that brought in different allochthonous materials during the rainfall. Similar observation have been previously reported by Atobatele and Ugwumba (2008) It was stated that water quality largely regulates the distribution and productivity levels of resident organisms, and that changes in it can alter natural biodiversity. On the other hand, the observed direct correlation between surface water temperature significantly contributions of these parameters to the recorded variation in the physico-chemical parameters of the lake, and their subsequent enhancement in the solubility of the introduced contaminants.

Accumulation levels in the fish muscles were habit dependent in the current study, with higher accumulations induced by the feeding habit of the fish species. The recorded higher concentration of copper in muscles of Common carp was high in February (1.69) and low in August (0.52) while it was high in June (1.03) and low in November (0.30) in Tilapia. The recorded higher concentration of Zinc in muscles of Common carp was high in June (57.74) and low in February (42.46) while it was high in June (48.59) and low in December (24.11) in Tilapia. The recorded higher concentration of Lead in muscles of Common carp was high in June (1.6) and low in December (0.68) while it was high in June (1.01) and low in May (0.48) in Tilapia. The recorded higher concentration of Chromium in muscles of Common carp was high in June (0.98) and low in March (0.42) while it was high in April

(0.90) and low (0.45) in August in Tilapia, may depend on feeding habit of this species that make it prone to more concentrations of the contaminant, unlike the other species that are carnivores. Who opined that bio-accumulations of heavy metals in fish depend on the fish species, size, age, type of tissue analyzed, feeding habit, and the habitat. Though the recorded concentrations in the heavy metals do not exceed FAO, maximum recommended value(20-30μg/g) in fish food, it is reported that the accumulation of essential metals in fish are generally higher and more homeostatic than the non-essential metals due to the crucial role played by the essential metals as precursors in most of the enzymatic activities.

The studied fish species in the lake during this study are considered safe for human consumption, since the recorded heavy metals concentration did not exceed the standard limit for aquatic life and drinking water.

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