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Monitoring of the Bioaccumulation of Heavy Metals in the Ashtamudi Lake, Kerala, Ramsar Site in Kerala

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Abstract: ***Aquatic ecosystem is a huge habitat for millions of organisms. The quality and status of this ecosystem will be the aftereffect of many anthropogenic activities. The freshwater and estuarine systems combine most of the inland fishery. Acute water pollution will leads to the eutrophication and affects the health of the aquatic organisms. Most of the aquatic pollutants are very dangerous and the results are not only limited to the organisms; but also it will leads to the bioaccumulation. It will also adversely affect human also. In the present study we are intending to check heavy metal concentrations such as copper, iron, lead in Prawn, Oyster, Etoplus and Mullet of Ashatamudi Lake. The heavy metal concentrations of water were also noted. Ashtamudi lake is included in the list of wetlands of the Ramsar Convention for the conservation of wetlands. Being included in the Ramsar sites, the conservation of the site is very important. Then also it is polluted a lot. The water quality index of Ashtamudi indicates that the lake is in a very dangerous condition. The concentrations of copper is in the increasing concentration of oyster (0.07 mg/l)<etroplus and mullet (0.1 mg/l)< prawn (0.9 mg/l).Iron concentration is in the order as oyster (1.9 mg/l)<prawn (2.8 mg/l)<etroplus (2.9 (mg/l)<mullet (3.4 (mg/l). Lead concentrations are in the concentrations of prawn (0.04 (mg/l) < etroplus (0.06 (mg/l)< oyster (0.66 (mg/l). The all samples are in the higher concentration of the metals. It need urgent attention for the protection.***

Keywords: heavy metal, cadmium, nickel, lead, bioaccumulation, water pollution, ecosystem

1. Introduction

Freshwater ecosystem of Kerala is in the extensive network of interconnected water bodies of and most of the production is consumed locally and marketed domestically. However, with the increasing urbanization and industrialization, discharge of untreated or partially treated sewage from industries, agricultural pesticides the water resources are getting polluted extensively and our fish resources are decreasing rapidly (kumar and Li., 2018). Ashshtamudi Lake is the largest wetland and brackish water in Kerala. It is also second largest wetland of Kerala, Kollam, Kerala, India. Due to high anthropogenic activities, urbanization practices, coconut shell retting and fishing activities along the bank habitations increases pollution threat (Surya Lekshmi Prasad K Mophin Kani, 2017; Nagaraj Sitaram, 2017). There are numerous works are there dealing with the heavy metal accumulation of fishes of fresh water (Mensoor D and Ali Said, 2018; Moiseenko T I and Gashkina N A., 2020). The heavy metals mainly found accumulated in our aquatic ecosystem were lead, iron, copper, zinc and cadmium (Kumar *et.al*, 2011). Lead is one of the main aquatic heavy metal pollutant will produce severe health issues (Tiwari. S.I.P *et.al*, 2013). The accumulation of iron may cause severe health problems like liver cancer, diabetes, cirrhosis of liver, many heart and lung infertility *etc* (Kumar *et.al*. 2017). Another heavy metal is copper, is one of the toxic metals, which causes many health hazards and harmful biochemical effects on living beings (Shrivastava A.K., 2009). Zinc accumulation will affect the hardness of the dilution water, the dissolved oxygen concentration, and temperature. At acute toxic concentrations the zinc concentration will probably kills fish by destroying gill tissues. At chronically toxic levels it may induce stress resulting in death. It is dangerous to human also (Bhattacharya.A.K., 2008)**.**The cadmium accumulation will cause severe destruction in fish muscle and gill and increased bioaccumulation will leads to lethal conditions (Ewa Dra˛g-Kozak., 2021).The aquatic ecosystems is in severe environmental degradation and pollution due to unscientific anthropogenic activities. The heavy metal accumulation in our aquatic ecosystem will leads to severe damage to fishes and bioaccumulation is also dangerous to higher tropic level even human too. So any activity which leads to the increased concentration of heavy metals must be monitored. In the present study the heavy metals of muscle of fishes in the Ashatamudi lake were checked. The fishes were selected for the study was mullet, oyster, etroplus and prawn. The main metals studied were iron, copper and lead. The data were tabulated and checked with statistical methods.

2. Materials and Methods

The main parameters under study were heavy metal accumulation in Prawn, Etroplus, Oyster and Mullet. The main heavy metals were iron, copper and lead. Muscle tissue was dissected from 10 randomly caught fish from each group Samples of muscles (about 5 g) were collected in order to determine iron, lead and copper levels. The muscle of the prawn, etroplus, oyster and mullet dissected and washed with normal saline. Removed the debris and blood properly.

2.1 Heavy metals analysis

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The determination of copper and lead were performed as describe by (Ismarti I et.al., 2017). The concentration of heavy metals concentration in water was also checked. All data were statistically analyzed and ANOVA test was conducted to compare significant differences among treatments using the SPS software and differences were considered significant when $p<0.05$.

2.2 Estimation of Copper

1-3 gm sample is weighed into a pre weighed crucible, ignited on hot plate and heated for 4hrs at 200 0C and let cool. Wet the ash with 3-4 ml nitric aurnaccid (1+1) added. Evaporated excess nitric acid on a hot plate. Returned crucible to furnace and heated over night at 450 0 C. when the ash is carbon free, dissolved in 10 ml HCl (1+1), filter into a volumetric flask up to 10 ml with distilled water. Aspirate the sample into AAS.

2.3 Estimation of Iron

A series of iron standards were taken by diluting from iron 10ppm solution & diluted to 100 ml in volumetric flask. 100 ml sample in another volumetric flask. 1 ml con:H_2SO_4 and 1ml con: HNO_3 were added and digested over on hot plate. Cooled filtered through acid whatsmann filter paper and make up to 100 ml. Analyzed on AAS.

2.4 Estimation of Lead

A series of lead standards were taken by Lead 1ppm solution diluted to 100 ml. 100 ml sample and each standards were taken into a conical flask, 1 ml con:HCl, 0.5 ml HNO3 were added and evaporated to 20 ml. Cooled, filtered through acid washed filter paper, make up to 100 ml. analyzed on AAS in graphite technique.

2.5 Bioconcentration factor (BCF).

Bioconcentration factors values for iron, lead and copper in muscle tissue are were analyzed based on metal concentration in water and on tissues of Prawn, Etroplus, Oyster and Mullet. BCF analysis performed to determine the accumulated level of Cu and Pb and Fe in samples. BCF of heavy metals in the samples calculated as

$$BCF = \frac{\text{C biota}}{C\ ambient\ medium}$$

Where C biota is the heavy metals concentration in the biota and C ambient medium for fish is the heavy metals

3. Result

3.1 Heavy metal accumulation in water

The water was tested for the presence of heavy metals such as copper, iron and lead the copper was found in 0.05 mg/l, iron was in 0.4mg/l and lead was in the concentration of 0.3 mg/l. The data were tabulated in the figure.3.1.

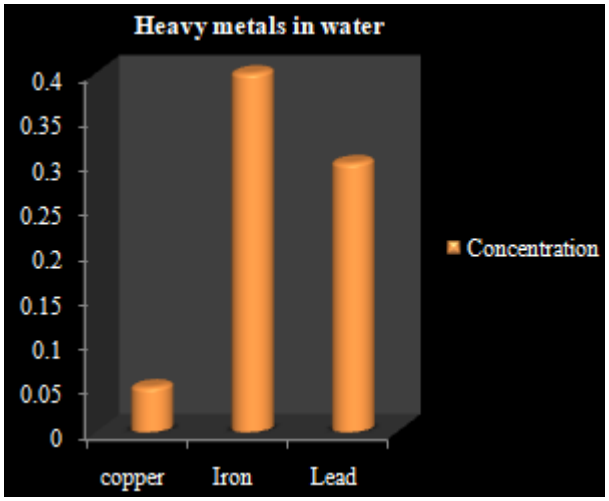

Figure 3.1: Heavy metal concentration in water of the selected area.

In prawn the copper concentration is 0.9 mg/l. Iron concentration was in 2.8mg/l. Lead was in 0.04 mg/l. Iron was found in higher concentration (figure.3.2 and figure.3.6). Lead was found in least amount (0.04mg/l).

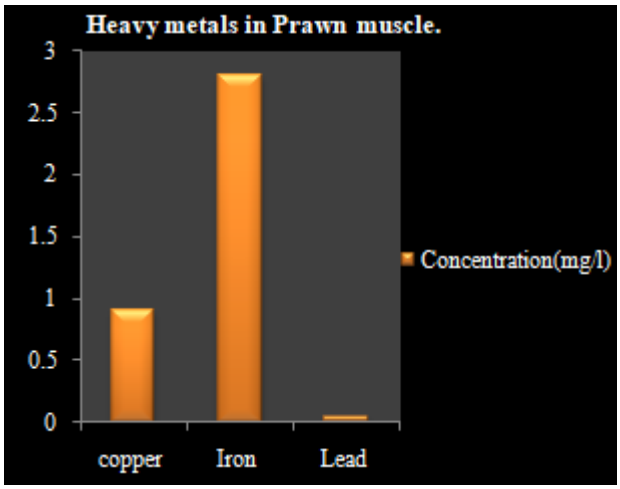

Figure 3.2: Heavy metal concentration in prawn muscle

In etroplus, the copper concentration is 0.1 mg/l. Iron concentration was in 2.9 mg/l. Lead was in 0.06 mg/l. Iron was found in higher concentration (figure.3.3 and figure.3.6). Copper was found in least amount (0.04mg/l).

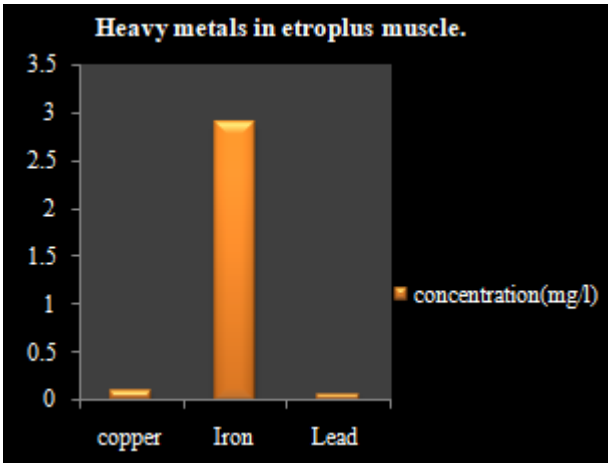

Figure.3.3: Heavy metal concentration in the muscle of etroplus

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In oyster the copper concentration is 0.07 mg/l. Iron concentration was in 1.9 mg/l. lead was in 0.066 mg/l. iron was found in higher concentration (figure.3.4 and figure.3.6). Lead was found in least amount (0.04mg/l).

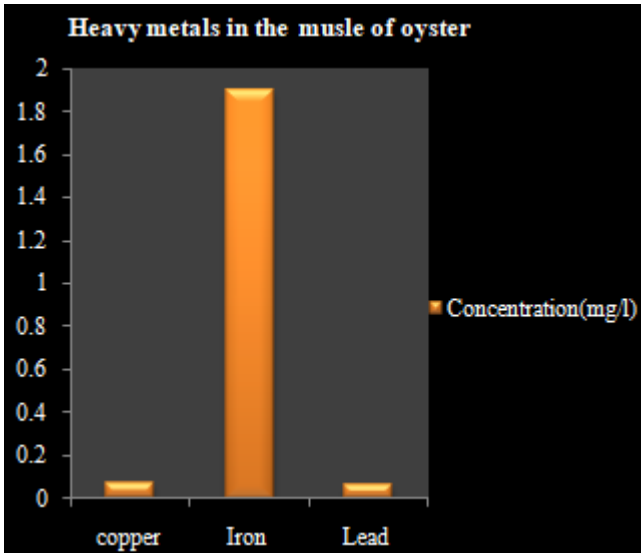

Figure 3.4: Heavy metal concentration in the muscles of oyster

In mullet the copper concentration is 0.1 mg/l. Iron concentration was in 3.4 mg/l. Lead was not detected. Iron was found in higher concentration (figure.3.5 and figure.3.6).

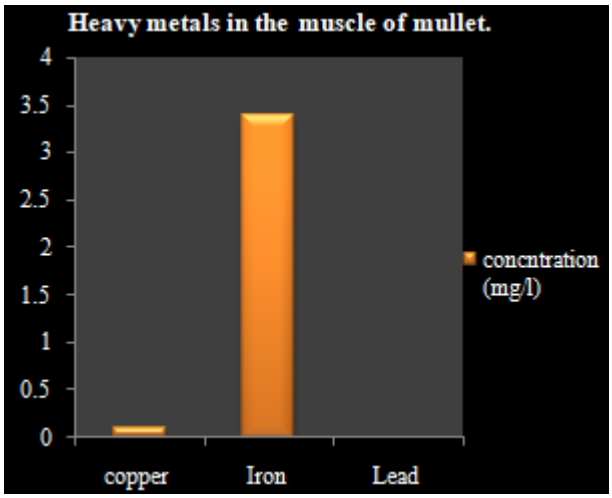

Figure 3.5: Heavy metal concentration in the muscle of Mullet

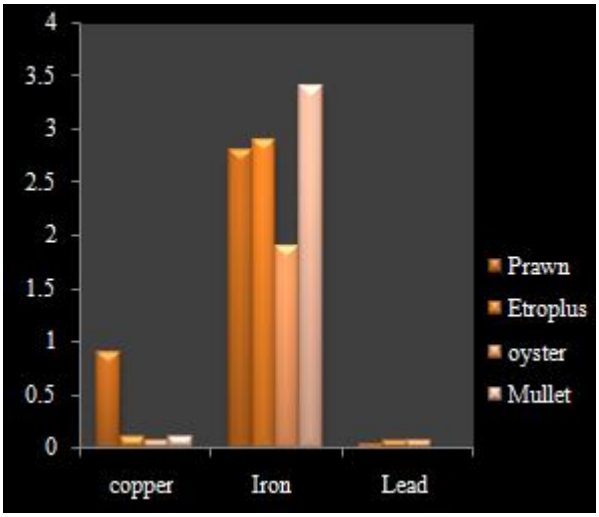

Figure 3.6: Heavy metal concentration in the samples

In the case of copper the when comparing with all the samples higher concentration was noted in the prawn (0.9 mg/l) followed by etroplus and mullet (0.1 mg/l), the least concentration was noted in the oyster (0.07 mg/l) (Figure.3.7).

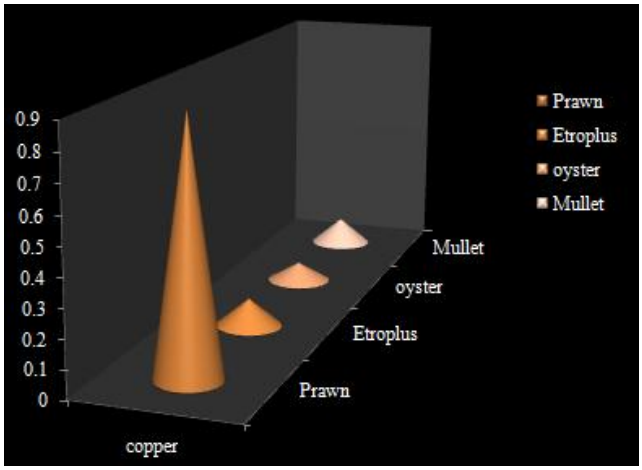

Figure 3.7: Heavy metal accumulation of copper

In the case of iron higher concentration was noted in the mullet (3.4 mg/l) followed by etroplus (2.9 mg/l), prawn (2.8 mg/l) and mullet (0.1 mg/l), the least concentration was noted in the oyster (1.9 mg/l) (Figure.3.8).

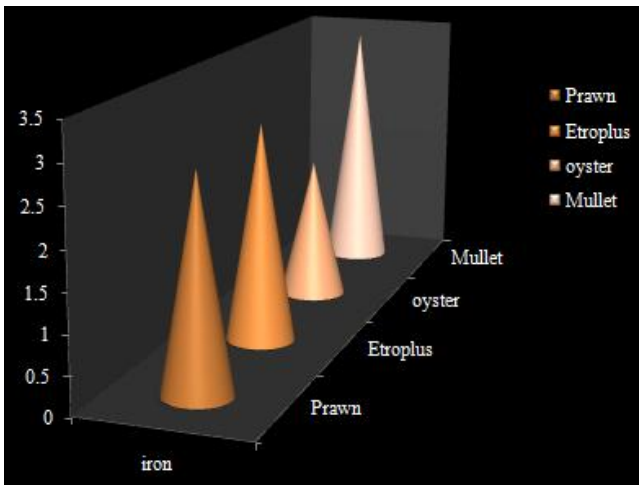

Figure 3.8: Heavy metal accumulation of iron

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In the case of lead higher concentration was noted in the oyster (0.066 mg/l) followed by etroplus (0.06 mg/l), prawn (0.04 mg/l). In mullet the concentration of lead is didn't detected (Figure.3.9).

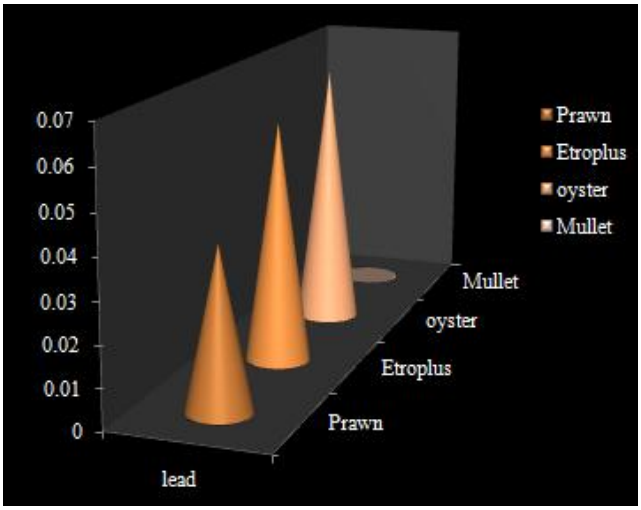

Figure 3.9: Heavy metal accumulation of lead

T**able 3.1:** Bio Concentration Factor (BCF) of samples for the heavy metals

	Prawn	Etroplus	Oyster	Mullet
Copper	18 ± 0.12	2 ± 0.12	1.4 ± 2.31	2 ±2.34
Iron	7±0.20	7.25±0.1	4.75±1.43	8.5±1.25
Lead	0.13±1.23	0.2±1.3	0.22±1.08	0

Bio Concentration Factor (BCF) of copper was higher in prawn (18±0.12). Least was observed in etroplus (2 ± 0.12). In the case of iron Bio Concentration Factor (BCF) was higher in mullet (8.5±1.25). Least was observed oyster (4.75±1.43). In the case of lead, Bio Concentration Factor (BCF) was higher in oyter (0.22±1.08), least in prawn (0.13±1.23). (Table.3.1).

4. Discussion

In the present study Ashatamiudi back waer, Kollam, Kerala was seletec for the study. Though Astamusi is one of the Ramsar site, it was getting polluted day by day the plloouted waste from corporation, oil pollution from Ksrtc stand and many more sources are there. There were many works are there dealing with the pollution of Ashtamudi lake (Prasad.L.S and Kani K.M., 2017; Antony, M., M and Ignatius., 2013; Najee and Philipose;2013). The heavy metal accumulation of fpor samples were collated such as Prwn, etroplus, oyster and mullet. ht muscle swere samped for the deterction of heavy metals such as iron, lead and copper. In theses iron concentrion is high. Concretation of heav metals in iron were estimatd (0.4mg/l)least was in copper (0.05 mg/l). in prawn iron was found to be Copper was found to be highe r in prawn (0.9 mg/l). least was observed in troplus and mullet (o.1 mg/l). iron concentration was higher in Mullet (3.4mg/l) least was found in oyster (1.9 mg/l). in the case of ead troplus was higher concentration (0.06 mg/l) and in mullet didn't deced the lead.

In species wise analysis, in prawn iron was in high amount (2.8mg/l)., least was lead (0.04mg/l). In etroplus iron was also in high amount (2.9mg/l) least was lead (0.04mg/l). in the case of oyster also iron was is in high amount (1.9mg/l).least was observed in lead (0.066mg/l). in mullet iron was in high amount 3.4mg/l). no lead was trced. Due to the pollution in Kerala in high most of the freshwaters are hghly polluted.som numerous workds are there dealing with the piece heavy metals in fishes (Bawuro *et.al.*, 2018; Jezierska and Witeska M., 2006; Javed.M, Usmani.N., 2011**).** Suami et.al., 2013 studied about the heavy metal accumulation in shrimp and oyster from. Atlantic Coast of the Democratic Republic of the Congo. High metal concentrations in investigated organisms' present potential consumer human health risks. Mohan *et.al.*, 2013 Compared the metal accumulation in the selected fishes from two sites of Vembanad backwaters, Kerala, India. The order of the heavy metals was in the order of Fe >Zn> Ni > Cu > Co> Mn. Beslin.L.G., 2020 was conducted a study on the heavy metals were analyzed from the sediments of Veli Lake. The five metals analyzed were copper, lead, manganese, nickel and zinc. Low levels of copper were observed in all the stations while comparing other metals. The seasonal variations were also noted for all the five metals and discussed.

In the case of Bioconcentration factor of copper higher value obtained in prawn (18 ± 0.12). in the case of iron BCF was higher in mullet (8.5±1.25). BCF of lead was higher in oyster (0.22±1.08). Kozak *et.al.*, 2011 was conducted a study on the BCF of cadmium and lead. Maurya P.K et.a;., 2019 assesses the potential human health risks posed by five heavy metals (Zn, Pb, Cu, Cd, and Cr) found inseven most consumable fish species (Cirrhinus mrigala, Cirrhinus reba, Catla catla, Lebio rohita, Crossocheilus latius, Clupisoma garua, and Mystus tengara) collected from local markets of Varanasi, Allahabad, Mirzapur, and Kanpur of Uttar Pradesh, India. In case of fish tissues, WHO reported the concentration of Pb, Cd, and Cr higher than the prescribed safe limits. The results determined that the highest heavy metals ccumulation was found settled in the liver of all selected fish species. Zn ranked the highest quantity, which was found in fish tissues with the concentration of 32.41 ± 2.55 µg/g in the gill of C. catla and 4.77 ± 0.34 µg/g in the gill C. Reba. The metals followed the magnitude order of Zn > Pb > Cu > Cd > Cr in selected fish tissues.

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