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HEAVY METAL CONCENTRATION OF FISH *Etroplus suratensis* FROM KAYAMKULAM BACKWATER, KERALA

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ABSTRACT

Kayamkulam estuary is one of the major estuarine systems in the southwest coast of India and is used for traditional fishing activity by local communities. The main objective of the present study was to assess the concentration of some heavy metals like As, Cd, Cu, Pb and Hg in gill, liver and muscle of a Etroplus suratensis, a food fish inhabiting Kayamkulam backwater .Fish samples were collected from four main sites and concentration of metals were determined by using Atomic Absorption spectrometry. The concentration of metal levels in fish tissue collected from Kayamkulam back water noticed a wide fluctuation. Arsenic 0.01 -0.09, Cadmium 0.001-0.009, Copper 0.005-0.09, Lead 0.001-0.009, Mercury 0.001-0.08 (n=12). Among the different metal concentration detected in the edible food fish ,the level of heavy metals were very low in about 90 % of the fish from the study area and the Kayamkulam back water was not exceeded the maximum level in food for human consumption specified by World Health Organisation. Comparison of the concentration of heavy metals in the gills, liver and muscle tissues revealed that the highest level of metals occurred in the liver tissues of fish .This results agreed the consumption of E.suratensis from Kayamkulam backwater may not pose any serious health risk to the human consumers.

KEYWORDS: Heavy Metal, Atomic Absorption Spectrometry, *Etroplus suratensis*

Pollution of heavy metals in aquatic ecosystem is growing at an alarming rate and has become an important worldwide problem (Malik et al., 2010). Some heavy metals are essential trace elements, most of them can be toxic to all forms of life at high concentrations due to formation of complex compounds within the cell. Unlike organic pollutants, heavy metals once introduced into the environment cannot be biodegraded. They persist indefinitely and cause pollution of air, water, and soils. Thus, the main strategies of pollution control are to reduce the bioavailability, mobility, and toxicity of metals. Methods for remediation of heavy metal-contaminated environments include physical removal, detoxification, bioleaching, and phytoremediation. Because heavy metals are increasingly found in microbial habitats due to natural and industrial processes, microorganisms have evolved several mechanisms to tolerate their presence by adsorption, complexation. In heavy metals, pollution abatement, microbial sensors, and transformations are getting increased focus because of high efficiency and cost effectiveness.

Heavy metals cannot be degraded, they are deposited, assimilated or incorporated in water, sediment and aquatic animals (Linnik and Zubenko, 2000) and thus, causing heavy metal pollution in water bodies (Malik et al., 2010). Heavy metals can be bioaccumulated and biomagnified via the food chain and finally assimilated by Human consumers resulting in health risks (Agah et al., 2009). As a consequence, fish are often used as indicators of heavy metals contamination in the aquatic ecosystem because they occupy high trophic levels and are important food source (Blasco et al., 1998; Agah et al., 2009).The main aim of the present study was to evaluate the concentration of some heavy metals in a fish Etroplus suratensis from Kayamkulam back water.

MATERIALS AND METHODS

Sampling Site

Kayamkulam kayal, is located parallel to the Kerala coast from Sankaramangalam in the south (Kollam district) to Karthikapalli in the north (Alappuzha district). The estuary lies between north latitudes 9°2' 16'' and east longitudes 76°25' 32'' .Four main sites were selected namely Ayiramthengu, Valiazheekal, Kochiyude Jetty, Choolatheruvu during August 2014 - july 2015.Fish samples were transported to the laboratory using cleaned polythene bags under chilled condition and kept at 20^0c till the analysis.

Sample Preparation

Fish samples were collected and allowed for thawing, then scales and the skin of fish were removed by using plastic knife to avoid metal contamination .The Gills, liver and muscle tissue were carefully taken into pre acid washed crucibles and they were homogenized separately. Then the sample were kept in a dry in oven at 100^0 c for more than 48 hours .The dried sample was then ground into a fine powder using a porela in motor and pestle. powdered fish tissues were digested on a hot plate using HNO_3 and perchloric acid in the ratio 2:1, completely digested samples were filtered through an acid resistant filter paper and filtrate made up to known volume

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(20ml) with distilled water. The content of heavy metal is estimated using Atomic Absorption Spectrophotometer (AAS).

Statistical Analysis

Data are presented as mean, standard deviation minimum and maximum of fish for each study sites. Sampling sites, metal type and tissue specific differences were statistically tested by analsis of variance (ANOVA). Mean values were compared by Tukey's test and $p<0.05$ was considerd as statistically significant (Zar.1996).

RESULTS

Table 1: Levels of metals in gills of *Etroplus suratensis* collected from four sites of Kayamkulam back water.

Sites	Arsenic	Cadmium	Copper	Lead	Mercury
Ayiramthengu	0.033+0.021 0.07+0.01	0.003+0.001 0.003+0.001	0.020 + 0.006 0.03 + 0.01	0.003+0.001 0.005+0.001	0.018+0.023 0.02+0.001
Valiazheekal	0.014+0.009 0.04+0.01	0.002+0.001 0.005+0.001	0.010+ 0.003 0.007 + 0.02	0.002+0.001 0.003+0.001	0.010+0.000 0.01+0.01
Kochiyude jetty	0.032+0.010 0.05+0.02	0.002+0.002 0.009+0.001	0.026 +0.009 0.04 + 0.01	0.003+0.001 0.005+0.001	0.012+0.004 0.01+0.012
Choolatheruvu	0.082+0.041 0.2+0.09	0.004+0.001 0.006+0.002	0.044+0.021 0.08 + 0.02	0.005+0.001 0.007+0.003	0.022+0.011 0.04+0.01

Metal level are presented as mean + standard deviation and ranges of minimum and maximum levels, n=12 (ANOVA, Tukey's test ,$p<0.05$).

Table 2: Levels of metals in liver tissues of *Etroplus suratensis* collected from four sites of Kayamkulam back water.

Sites	Arsenic	Cadmium	Copper	Lead	Mercury
Ayiramthengu	0.043+0.026 0.09+0.02	0.008+0.010 0.007+0.002	0.028+0.009 0.04 + 0.01	0.004+0.002 0.007+0.002	0.018+0.023 0.001+0.04
Valiazheekal	0.024+0.014 0.05+0.01	0.003+0.002 0.009+0.001	0.019+0.008 0.03 + 0.01	0.003+0.002 0.009+0.001	0.010+0.000 0.01+0.01
Kochiyude jetty	0.032+0.013 0.06+0.02	0.004+0.003 0.009+0.001	0.034+0.010 0.05+ 0.02	0.004+0.001 0.006+0.003	0.012+0.004 0.012+0.02
Choolatheruvu	0.095+0.035 0.2+0.07	0.003+0.001 0.006+0.002	0.048+0.020 0.09 + 0.02	0.005+0.002 0.008+0.003	0.022+0.021 0.08+0.01

Metal level are presented as mean + standard deviation and ranges of minimum and maximum levels, n=12 (ANOVA, Tukey's test ,$p<0.05$).

Table 3: Levels of metals in muscle tissues of *Etroplus suratensis* collected from four sites of Kayamkulam back water.

Sites	Arsenic	Cadmium	Copper	Lead	Mercury
Ayiramthengu	0.040+0.029 0.08+ 0.01	0.005+0.004 0.009+0.001	0.023+ 0.007 0.03+ 0.01	0.003+0.001 0.004+0.001	0.018+0.023 0.001+0.04
Valiazheekal	0.017+0.010 0.04+ 0.01	0.003+0.003 0.009+0.001	0.009+ 0.001 0.01+ 0.006	0.002+0.002 0.003+0.001	0.010+0.000 0.01+0.01
Kochiyude jetty	0.041+0.017 0.07+ 0.02	0.003+0.003 0.009+0.001	0.008+0.002 0.01+ 0.005	0.002+0.001 0.004+0.001	0.012+0.004 0.02+0.012
Choolatheruvu	0.078+0.019 0.1+ 0.05	0.003+0.003 0.009+0.001	0.015+0.005 0.02+ 0.01	0.003+0.002 0.008+0.001	0.018+0.007 0.03+0.01

Metal level are presented as mean + standard deviation and ranges of minimum and maximum levels, n=12 (ANOVA, Tukey's test ,$p<0.05$).

Metal Levels in Gills and Liver Tissue

The concentration of five metals in the gills and liver tissues of E. suratensis collected from four sites of the Kayamkulam backwater was presented in table 1and 2 respectively. Among the five metals, was the predominant metal present in gills and liver tissues. Site specific comparison indicate that the concentration of metals in the

gills followed a pattern: Mercury, Choolatheruvu > Ayiramthengu> Kochiyude jetty> Valiazheekal, Lead : Choolatheruvu > Ayiramthengu = Kochiyude jetty> Valiazheekal ,Cadmium : Choolatheruvu > Ayiramthengu = Kochiyude jetty = Valiazheekal ,Arsenic : Choolatheruvu > Ayiramthengu > Kochiyude jetty > Valiazheekal,Copper : Choolatheruvu > Kochiyude jetty > Ayiramthengu > Valiazheekal. The levels of five metals in the Liver of E.suratensis following the pattern : Mercury : Choolatheruvu > Ayiramthengu > Kochiyude jetty > Valiazheekal ,Lead: Choolatheruvu >Ayiramthengu = Kochiyude jetty > Valiazheekal, Cadmium : Ayiramthengu > Kochiyude jetty > Choolatheruvu > Valiazheekal, Arsenic : Choolatheruvu > Ayiramthengu > Kochiyude jetty > Valiazheekal, Copper : Choolatheruvu > Kochiyude jetty > Ayiramthengu > Valiazheekal. The measured heavy metals level in the gills and liver of the fish collected from Choolatheruvu (except cadmium level in liver) were comparatively higher than the levels in the fish from other sites in the backwater.

Metals Level in Muscle Tissue

The amount of heavy metal in the muscle tissue of E.suratensis collected from four site are presented in table 3.The metals level in muscle tissue were comparatively lower than the gills and liver tissue.Site specific comparison of metals in muscle tissues showed following order : Mercury : Choolatheruvu > Ayiramthengu > Kochiyude jetty > Valiazheekal, Lead : Choolatheruvu = Ayiramthengu > Kochiyude jetty =Valiazheekal, Cadmium : Ayiramthengu > > Choolatheruvu = Kochiyude jetty =Valiazheekal ,Arsenic : Choolatheruvu > Kochiyude jetty > Ayiramthengu > Valiazheekal, Copper : Ayiramthengu > Choolatheruvu >> Valiazheekal> Kochiyude jetty.

DISCUSSION

The presence of heavy metals noticed in fish in this study were generally low when compared within the limit of chronic reference values suggested by WHO (1985) and USEPA (1986). Heavy metal contamination in sediment can affect the water quality and bioaccumulation of metals in aquatic organisms, resulting in potential long-term implication on human health and ecosystem (Fernandes et al., 2007). Concentration of selected five heavy metals in gills, liver and muscle tissues of E. suratensis from Kayamkulam backwater noticed different capability for metal accumulation. Generally, the accumulation of metal was occurred to be high in liver tissue when compared to gills and muscle. The results of the present study showed that, liver accumulate and concentrate highest concentrations of Cu and As. Accumulation of Lead and Arsenic occur in the liver of fish. Arsenic is released in the environment through natural processes such as weathering, and may circulate in natural ecosystems for long time. A well recognized arsenic problem of groundwater in West Bengal was first reported in the late 1980s. Cadmium is a non-essential toxic metal, and may accumulate in humans from food chain magnification. Cadmium could be readily bioaccumulated in lower portion of food chain and bio-concentrate in multiple organs of fish. Jent et al. (1998) found that, Cd and Cu concentration increased in fish liver collected from water near the agricultural areas. Fish is the main source of Hg in human diet (Malik et al., 2010), Hg was recorded to be the lowest accumulating metal during this study. The present results supports with those obtained by Malik et al. (2010).This study reveals that muscle tissues of E.suratensis is not an active organ of heavy metal accumulation.The accumulation of metals in the liver and gills of fish may not pose a health hazardness to human because these parts of fishes are nt edible parts. Accumulations of metals were generally found to be species specific and may be related to their feeding habits and the bio-concentration capacity [Z. Friba,.et.al].So this study reveals that, Kayamkulam backwater is by most suitable for fishing activity and consumption of this species of fish is safe.

In conclusion the analysis of heavy metals in fish sample indicates the level of arsenic, cadmium, copper, lead And Mercury were not exceeded the limits specified by the international authorities. The organ specific comparison of heavy metals level indicated that the highest concentration was found to noted in liver tissues and site specific comparison of five heavy metals in fish collected from Choolatheruv was comparatively higher than the other three sites. It is therefore Concluded that the fish samples from the various study sites are fit for domestic consumptions as the Samples studied did not indicate any harmful or extremely high chemical content that may affect the health of those consuming the fishes.

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