



Levels of Some Heavy Metals in Tissues of Bonga Fish, *Ethmallosa fimbriata* (Bowdich, 1825) from Forcados River

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ABSTRACT: The levels of some heavy metals in the tissues of *E. fimbriata* from Forcados River were investigated to assure the suitability of the fish for human consumption. A total of 344 *E. fimbriata* fish samples were purchased from fishermen on the bank of the river at Burutu fortnightly for six months during the dry season. Water and sediment samples from the river were also collected using sterile 1litre and 500 ml plastic container for water and sediment samples respectively. All three samples (fish tissues, water and sediment) were analyzed for levels of heavy metals (zinc, cadmium, copper, lead and nickel) using the Atomic Absorption Spectrophotometer. Tissues of *E. fimbriata* analyzed accumulated some heavy metals. Water and sediment samples from Forcados River were also observed to have heavy metals. The levels of zinc in tissues of *E. fimbriata*, water and sediment samples were not significantly ($P>0.05$) different. The levels of cadmium, copper, lead and nickel in tissues of *E. fimbriata* and water were also not significantly ($P>0.05$) different. However, sediment samples had significantly ($P<0.05$) higher levels of cadmium, copper, lead and nickel than in the tissues of *E. fimbriata* and water samples. The observed levels of zinc and cadmium in this study exceeded the WHO maximum permissible limit while copper, lead and nickel were within the WHO set limits. *E. fimbriata* from Forcados River are contaminated with heavy metals and may be toxic to other aquatic fauna and poisonous to human consumers.

Keywords: Heavy metals, levels, *E. fimbriata*, Forcados River.

INTRODUCTION

Human mediated industrial activities have increased in recent times leading to the introduction of many potentially hazardous inorganic compounds into the environment [1]. The aquatic environment receives influx of industrial waste arising from manufacturing, mining, agricultural, domestic waste water, metal finishing plants and atmospheric precipitation [2]. Natural aquatic systems may extensively be contaminated with heavy metals released from domestic, industrial and other man-made activities [3]. Heavy metal contamination may have devastating effects on the ecological balance of the recipient environment and on the diversity of aquatic organisms [4].

Aquatic organisms have been reported to accumulate heavy metals from various sources including sediments, soil, erosion and discharges of waste water [5, 6]. Fish is widely used to evaluate the health of aquatic ecosystem due to

build-up of pollutants in the aquatic food chain leading to adverse effects and death [7, 8].

Some heavy metals are essential in trace concentrations for the maintenance of body metabolism, growth and general well being of living organisms. However, at higher concentrations heavy metals can lead to poisoning. The toxic effects of heavy metals on aquatic organisms range from complete loss of biota to subtle effects on rates of reproduction, growth and behaviour of organisms [9, 10]. The coastal aquatic ecosystems of the Niger Delta region of Nigeria have recently received much attention due to the frequent accidental or deliberate oil spills, untreated industrial waste water and sewage discharges and agricultural run-offs. Oil exploitation and exploration activities are prevalent in the upper reaches of this coastal ecosystem.

The Forcados River is one of the numerous downstream rivers in the Niger Delta. The river is a notable source of Bonga fish, *Ethmallosa fimbriata*, which is a popular fish

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and source of protein in the diet of the people of the Niger Delta [11]. This study investigates the levels of some heavy metals in the tissues of *E. fimbriata* from Forcados River to assure the suitability of the fish for human consumption.

MATERIALS AND METHODS

The Forcados River situated on latitude 5.38° N and longitude 5.32° E, is a channel in the Niger Delta of southern Nigeria [12]. It flows from approximately 198 km meeting the sea at the Bight of Benin in Delta State. It is an important channel for small ships and covers a distance of 30.3 km from Warri River (Figure 1). A total of 344 *E. fimbriata* fish samples were purchased from fishermen on the bank of the river fortnightly for six months from April to September in 2010. The fish samples used ranged in size from 22.5 - 28.4cm total length and 107.0 - 218.9g in weight. Water and sediment samples from the river were collected using sterile 1 litre and 500 ml plastic container for water and

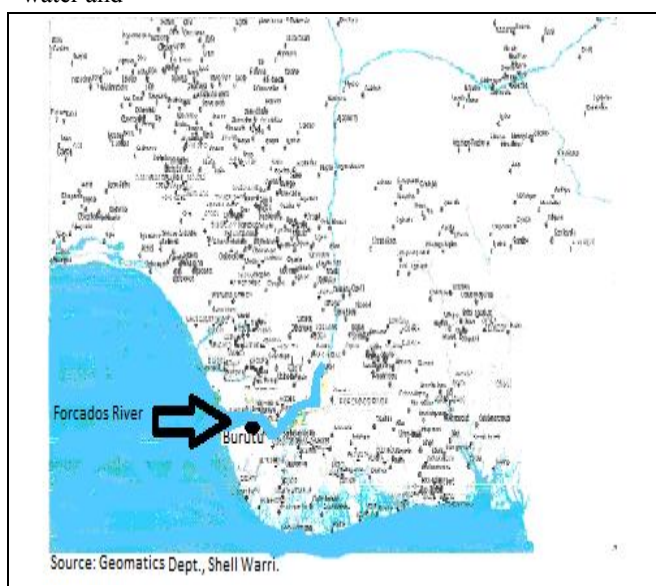


Figure 1: Map of Nigeria showing Forcados River and study location at Burutu

Sediment samples respectively. After sample collection on each sampling day, samples were immediately transported to the laboratory for analyses. In the laboratory, fish samples were measured (total length, weight and body depth). Two grams of fish tissue was digested in 20 ml nitric acid, perchloric acid and hydrogen peroxide 1:1:4 solution and heated on an electric burner for 30 minutes till all fumes were expelled and fish tissues dissolved completely. The beaker and its content were allowed to cool and thereafter

the digested sample made up to 50ml. Two ml sulphuric acid was added to 1 litre of water sample to adjust the pH and two gram of sediment sample digested as with the fish tissues sample. All three samples (fish tissue, water and sediment) were analyzed for levels of heavy metal using the Atomic Absorption Spectrophotometer (AAS) model-Perkin almer Analyst 200. Data collected were analyzed with analysis of variance at P=0.05 and significant means separated using Duncan Multiple Range Test (DMRT).

RESULTS

Tissues of *E. fimbriata* examined were accumulated some heavy metals. Water and sediment samples from Forcados River were also observed to have heavy metals. Fish tissues accumulated more of zinc (9.67mg/kg) than other heavy metals and least of lead (0.33mg/kg). Water samples also had more zinc (76.25mg/l) than other heavy metals and least of lead (0.64mg/l). Sediment samples had more copper (82.78mg/kg) than other heavy metals. Lead was also observed to be lower in level with 9.43 mg/kg in sediment samples. While zinc had higher level in water than in fish and sediment samples, lead was higher in sediment than in fish and water samples. Mean levels of heavy metals in tissues of *E. fimbriata*, water and sediment samples are presented in table 1.

Table 1: Mean levels of heavy metals in tissues of *E. fimbriata*, water and sediment samples from Forcados River.

Heavy metals	Fish (mg/kg)	Samples Water (mg/l)	Sediment (mg/kg)
Zinc (Zn)	9.67±0.60	76.25±5.83	34.61± 7.26
Cadmium (Cd)	2.16±0.56	10.25±1.92	39.89±38.59
Copper (Cu)	1.31±1.15	20.70±1.14	82.78±42.36
Lead (Pd)	0.33±0.18	0.64±0.25	9.43± 1.84
Nickel (Ni)	7.67±1.31	5.16±2.79	42.37±11.17

The levels of zinc in tissues of *E. fimbriata*, water and sediment samples were not significantly (P>0.05) different. The levels of cadmium, copper, lead and nickel in tissues of *E. fimbriata* and water were also not significantly (P>0.05) different. However, sediment samples had significantly (P<0.05) higher levels of cadmium, copper, lead and nickel than in the tissues of *E. fimbriata* and water samples. Zinc and cadmium in this study exceeded the FAO/WHO maximum permissible limit while copper, lead and nickel were within the FAO/ WHO set limits. Tables 2 and 3 show the mean difference in levels of heavy metals analyzed and

the mean levels of heavy metals in tissues of *E. fimbriata* River compared with maximum permissible limits respectively.

Table 2: Mean difference in levels of heavy metals in tissues of *E. fimbriata*, water and sediment samples from Forcados River.

Heavy metals	Fish	Samples Water	Sediment
Zinc	1.0000 ^a	1.0000 ^a	1.0000^a
Cadmium	0.3710 ^a	0.3710 ^a	1.0000^b
Copper	0.1300 ^a	0.1300 ^a	1.0000^b
Lead	0.6730 ^a	0.6730 ^a	1.0000^b
Nickel	0.7090^a	0.7090^a	1.0000^b

Means on the same row with different superscripts are significantly different (P<0.05).

Table 3: Mean levels of heavy metals in tissues of *E. fimbriata* River compared with maximum permissible limits.

Heavy metals (mg/kg)	Levels in tissues	Maximum Permissible limit FAO/WHO[13]
Zinc (Zn)	*9.67	5.0
Cadmium (Cd)	*2.10	0.5
Copper (Cu)	1.31	20.0
Lead (Pb)	0.33	1.50
Nickel (Ni)	7.67	80.0

*Levels higher than maximum permissible limits.

DISCUSSION

Fish tissues, water and sediment samples from Forcados River analyzed in this study are contaminated with heavy metals. It has been reported that aquatic organisms have the ability to accumulate heavy metal from various sources

including soil, erosion and discharge of waste water [6]. Heavy metals such as cadmium, lead, copper and zinc are regarded as serious pollutants because of their toxicity and tendency to be incorporated into food chain and their ability to remain in an environment for a long time [14]. The aquatic medium is home to fishes and so fishes are unable to escape from the detrimental effects of these pollutants which are non-degradable. Forcados River has previously been reported to be contaminated with heavy metals resulting from oil exploration and exploitation activities [15, 16, 17, 18]. Heavy metal contamination may have devastating effects on the ecological balance of the recipient environment and diversity of aquatic organisms such as fish [4]. The toxic effects of metals in aquatic ecosystems ranged from a complete loss of biota to subtle effects on rates of reproduction growth and mortality of organisms [7, 8]. Significantly (P<0.05) higher levels of cadmium, copper, lead and nickel were observed in the sediment than in fish tissues and water samples. This is an indication of probably long time accumulation of heavy metal in the sediment. Marine sediments has been observed to constitute part of the contaminants in aquatic environment [19, 20]. It has also been reported that the bottom sediment serves as a reservoir for heavy metals [21].

The observed levels of zinc and cadmium in this study exceeded the WHO maximum permissible limit while copper, lead and nickel were within the WHO set limits. *E. fimbriata* from Forcados River are contaminated with heavy metals and may be toxic to other aquatic fauna and poisonous to human consumers Constant monitoring of levels of contamination is necessary to assess the impact of heavy metals in the aquatic system.

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