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# Trace metals distribution in synodontis membranaceus, sediments, Asystasia Gangetica and Platostoma Africanium from Ofuafor River around Delta Glass Factory in Ughelli North Local Government Area, Delta State Nigeria

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**Abstract**: The trace metals analysis in synodontis membranaceus (head and tail), bottom sediments, Asystasia Gangetica and Platostoma Africanium were carried out using atomic absorption spectrometer of model Perkin Elmer 3110. Metals analysed were copper, nickel, mangenese, chromium, iron lead and cobalt. These metals were detected in the above samples. Vegetation samples concentration in copper, manganese, chromium, iron and cobalt were higher than those obtained in bottom sediments. The tail part of the fish contents of trace metals were also higher than those of the head. The results obtained in this work exceeded the results of water analysis carried out by Omoregha on the same river. Metals such as copper, nickel, manganese and chromium were below detection limit in the water from the same river. The bioaccumulation of these trace metals in these samples were traced to activities of Delta Glass Factory.

**Keywords**: trace metals; Ofuafor River; bioaccumulation of metals; contamination industrial effluents; Delta Glass Factory

## Introduction

Man dirties the air with gas and smoke, poisons the water with chemicals and other substances, and damages the soil with too many fertilizers and pesticides. People ruin the earth's natural beauty by scattering junk and litter on the land and in the water. The badly polluted air can cause illness, and even death, the polluted water kills fish and other marine life, and the polluted soil leads to a reduction of the amount of land available for growing food. Factories discharge most of the materials that pollute the air and water.

Fish may absorb dissolved heavy metals room the surrounding water into the tissue and various organs (Adams, 1980). Kakula *et al*. (Kakula, 1987) observed that the concentration of heavy metals in water is an indication of aquatic metal burden through fish. Ezemonye and Egborge (Ezemonye, 1992) observed variable metal levels in the dominant fish species of carnivore and detrivorie. They further observed that carnivore fish species have the lowest heavy metal levels except vanadium and attributed this to efficient home ostatic mechanisms in fish. The level of copper, iron, lead and manganese observed (Afolabi, 1988) in the fish in his study were lower than the dry weight level of dominant fish species in Warri River. Egarlga (Egarlga, 1992) measured the levels of mercury, lead and cadmium in the muscles, liver, and kidney of three groups of fishes from Warri River. She observed that the wet weights ranged from 0.02—0.56 mg/kg in the muscles and 0.01—0.31mg/kg in the liver and kidneys for mercury, 0.04—0.47 mg/kg in the muscles and 0.01—0.48 mg/kg in the livers and kidneys or lead and 0.02—0.07 mg/kg in the muscles and 0.03—0.29 in the livers and kidneys for cadmium.

Ndiokwere and Guinn (Ndiokwere, 1983), Onnishakin (Onnishakin, 1986) and Osibanjo and Ajayi (Osibanjo, 1980) reported that untreated liquid wastes from many industries in Lagos are discharged into the Lagos Greeks. They added that some non-degradable industrial effluents like in organic salts and other chemical raised the acidity or alkalinity of streams, often to a point at which living organisms cannot survive. Little and Martins (Little, 1972) pointed out that iron and steel industries contribute iron, manganese, lead, zinc and some other heavy metals to the environment, especially aquatic environment as exemplified by the steel works near rivers. Liebemberg (Liebemberg, 1972) stated that heavy metals are introduced into the environment through a number of sources, some of which include geological weathering, mining effluents, industrial effluents, domestic and urban storm-water run offs, and natural disasters. He confirmed that in Wales, damages were done by effluents made up mainly of toxic elements discharged from a mine in central Wales into Water bodies. Anders (Anders, 1986) stated that the aging of water body known as eutrophication, can lead to a build-up of sediments on the water floor. Lobbi (Lobbi, 2000) in a statement released to Newsmen in Warri, said that the oil spillage occurred at Eriemu Well 13 in Ughelli North area. He added that the immediate vicinity has been affected by the resultant spill. Rotimi (Rotimi, 2000) reported that every part of Nigeria faces challenging environmental issues from flooding and erosion in the south to desertification in the North and waste management problem in every state of the federation. Rolfe and Jennette (Jennette, 1975) reported that soil contamination due to smelling extends to, as least 15 km north and south around the new lead belt of Missouri, USA. Ndiokwere (Ndiokwere, 1985) reported that average levels of arsenic (597 μg/g), chromium (498 μg/g) and copper (763 μg/g) occurred at sites within about 200 metres from wood treatment factory. He added that high levels of these metals were found in soil, vegetation and crops grown within the factory premises. The inhabitant of Ekakprame (1999) would not forget the spilled petroleum which set place ablaze, killing all aquatic life and taken away the people's means of livelihood.

The presence of Delta Glass Factory at Ughelli is suspected to have been polluting the Ofuafor River as a result of the discharge of effluents and glass particles into it. It therefore became necessary to carry out this study. Therefore, the objectives of this study are to find the sources of pollutants; to find the levels of bioaccumulation of trace metals and to find the effects of these metals on man, aquatic life and the environment.

## 1 Study area

Ofuafor River is about 500 metres downstream to Delta Glass Factory in Ughelli North. It is the receiving and of wastes and effluents discharged from the glass factory.

## 2 Materials and methods

Twenty samples were obtained in the Ofuafor River about 500 metres downstream Delta Glass Factory in Ughelli North Local Government Area of Delta State. The samples collected were synodentis membraneceus (cat fish), bottom sediments, Asystasia Gantetica (vegetations) and Platostoma Africanium (vegetations). The catfish were collected directly by Mr. John Okafor (a fisherman). The fish were taken to the zoologist for naming, after which they were taken to the laboratory for preservation. The fish were further deserted and dried with solar energy. The dried parts (the head and the tail) were returned to the laboratory for further preservation in the refrigerator in plastic bottles with corks. The sediments were collected from the bottom of the river in a polyethylene plastic with cork. The sediments were kept in clean cardboard papers and were dried for two days using solar energy. The two different species of vegetations were collected from the river and were kept in polyethylene bags to avoid contamination. The vegetations were taken for identification by Mr. Dave Ajakporise of Agricultural Department, College of Education, Warri. The vegetative samples were dried in a clean papers using the solar energy for three days. The bottom sediments and vegetative samples were also kept in the refrigerator in the laboratory.

5.00g of each sample were weighed before digestion. The fish samples (the head and tail) and vegetations were grinded into small particles in mortars with pestles. The samples were put into each 250 ml Kjeldahl fish for digestion. A uniform ratios of acid mixtures 10 ml $HNO_3$ and 10 ml $HCClO_4$ were added into each flask. This was followed with constant stirring. The digests were placed on hot plates for some minutes until nitrous oxide gas were evolved in fish and vegetation samples. In the case of bottom sediments, hydrogen chloride gas was evolved. The solutions were transferred into the fume cupboard in the analytical laboratory where they remained for over night. On cooling, the digested solutions were filtered and made up to 100 ml with de-ionized water in volumetric flasks. The solutions were transferred into clean sample bottles and returned to the laboratory for atomic absorption spectrometry analysis.

## 3 Results and discussion

The head and tail of synodontis membranaceus (catfish) bottom sediment, Asystasia Gantetica and platosto Africanium samples were analysed using atomic absorption spectrometry (AAS). The metal concentrations in mg/kg dry weights are shown in Table 1.

Table 1 The metal concentrations

| Samples | Metals in mg/kg dry weight | | | | | | |
|---|---|---|---|---|---|---|---|
| | Cu | Ni | Mn | Cr | Fe | Pb | Co |
| Head of | 0.15 | 1.65 | 1.48 | 1.65 | 15.51 | 0.85 | 0.18 |
| synodontis | 0.23 | 1.73 | 1.46 | 1.75 | 15.48 | 0.78 | 0.19 |
| membranaceus | 0.22 | 1.72 | 1.54 | 1.68 | 15.49 | 0.82 | 0.21 |
| (catfish) | 0.20 | 1.70 | 1.52 | 1.72 | 15.52 | 0.75 | 0.22 |
| Tail of | 0.27 | 2.38 | 1.77 | 2.55 | 21.79 | 0.32 | 0.32 |
| synodontis | 0.33 | 2.36 | 1.83 | 2.40 | 21.81 | 1.08 | 0.28 |
| membranaceus | 0.29 | 2.44 | 1.79 | 2.60 | 21.85 | 1.05 | 0.32 |
| (catfish) | 0.31 | 2.42 | 1.81 | 2.45 | 21.75 | 1.12 | 0.33 |
| Bottom sediments | 0.045 | 0.30 | 0.375 | 0.47 | 20.25 | 0.71 | 0.011 |
| | 0.055 | 0.32 | 0.385 | 0.53 | 20.29 | 0.70 | 0.009 |
| | 0.048 | 0.29 | 0.378 | 0.49 | 20.28 | 0.74 | 0.008 |
| | 0.052 | 0.33 | 0.382 | 0.51 | 20.26 | 0.73 | 0.012 |
| Asystasia | 0.34 | 0.145 | 37.02 | 0.80 | 22.38 | 0.182 | 0.315 |
| Grangetica | 0.38 | 0.155 | 37.00 | 0.83 | 22.30 | 0.175 | 0.319 |
| (vegetation) | 0.35 | 0.148 | 37.00 | 0.82 | 22.32 | 0.178 | 0.325 |
| | 0.37 | 0.152 | 37.06 | 0.79 | 22.38 | 0.185 | 0.321 |
| Platostoma | 0.41 | 0.50 | 21.30 | 0.71 | 21.71 | 0.315 | 0.144 |
| Africanium | 0.43 | 0.50 | 21.30 | 0.68 | 21.85 | 0.325 | 0.138 |
| (vegetation) | 0.43 | 0.49 | 21.34 | 0.69 | 21.75 | 0.320 | 0.136 |
| | 0.42 | 0.51 | 21.34 | 0.72 | 21.81 | 0.320 | 0.142 |

Copper levels were detected in all the samples but the bottom sediment had the lowest value. Platostoma Africanium has the highest copper level among all the samples. Since platostoma level is higher than that of Asystasia Gangetica, it means that bioaccumulation of metal varies with different species. Considering the levels of accumulation of copper in parts of catfish, the tail contained a higher level than the head.

Nickel levels were detected in all the samples analysed the fish parts had the highest values (fish head: 1.7 mg/kg and the tails 2.40 mg/kg dry weight). Nickel value in platostoma Africanium (0.50 mg/kg dry weight) was higher than those of Asystasia Gangetica (0.15 mg/kg dry weight) and bottom sediment (0.31 mg/kg dry weight). Nickel level was below detection limit in water obtained in the same river (Omoregha, 2000).

**Table 2 Mean concentrations of 95% confidence limit of trace metals in synodontis membranaceus (head and tail), bottom sediment, Asystasia Gantetica and Platostoma Africanium samples($N = 4$)** Unit: mg/kg dry weight

| Samples | Cu | Ni | Mn | Cr | Fe | Pb | Co |
|---|---|---|---|---|---|---|---|
| Head of synodontis membranaceus | 0.20 ± 0.06 | 1.7 ± 0.06 | 1.50 ± 0.06 | 1.70 ± 0.07 | 15.5 ± 0.03 | 0.80 ± 0.07 | 0.20 ± 0.03 |
| Tail of synodontis membranaceus | 0.3 ± 0.04 | 2.40 ± 0.06 | 1.80 ± 0.04 | 2.5 ± 0.2 | 21.8 ± 0.06 | 1.10 ± 0.07 | 0.30 ± 0.04 |
| Bottom sediment | 0.05 ± 0.01 | 0.31 ± 0.04 | 0.38 ± 0.01 | 0.50 ± 0.04 | 20.27 ± 0.03 | 0.72 ± 0.03 | 0.01 ± 0.003 |
| Asystatia Gangetica (vegetation) | 0.36 ± 0.03 | 0.15 ± 0.01 | 37.02 ± 0.05 | 0.81 ± 0.03 | 22.34 ± 0.070 | 0.81 ± 0.01 | 0.32 ± 0.01 |
| Platostoma Africanium (vegetation) | 0.42 ± 0.01 | 0.50 ± 0.01 | 21.32 ± 0.04 | 0.70 ± 0.03 | 21.78 ± 0.105 | 0.32 ± 0.01 | 0.14 ± 0.01 |

Manganese levels were found in all the samples analysed in this work, but was below detection limit in water sample analysis carried out by Omoregha (Omoregha, 2000). Bioaccumulations of nickel metal were highest in vegetation samples when compared with those of fish part and bottom sediments. The accumulation of manganese in these samples revealed that the source must be attributed to the activities of the Delta Glass Factory. The levels of manganese in vegetations are within those obtained by Peng *et al*. (Peng, 1997) in China (22—155 μg/g).

Chromium level was below detection limit in water analysed by Omoregha (Omoregha, 2000), but was found in all the samples in this work. Bioaccumulation levels were higher in fish parts when compared with those of bottom sediment and vegetation samples. Chromium contents in vegetations (Asystasia Gangetica: 0.81 mg/kg and platostoma Africanium: 0.70 mg/kg) fell within the range of 0.28—0.73 μg/g obtained by Peng *et al*. (Peng, 1997). The bioaccumulation of chromium in these samples may be attributed to chromium compounds used by the factory in manufacturing bottles. These high values may affect aquatic life.

The iron levels obtained in the samples were approximately equal except that found in fish head. The iron level in water analysed by Omoregha (Omoregha, 2000) was 0.37 ppm. This revealed that the source of iron is not from the water. The fish, sediment and vegetations accumulate iron from effluent discharged from the factory.

Lead levels were detected in all the samples including water analysis carried out by Omoregha (Omoregha, 2000), which had 0.06 ppm lead. Lead levels in vegetation were lower than the vegetation range of 0.4—3.61 $\mu g/g$ found in China by Peng *et al*. (Peng, 1997). Bioaccumulation of lead in fish parts and bottom sediment were higher than those of vegetation samples. These high levels of lead in Ofuafor River may have long-term effect in man and aquatic life. Serious accumulation of lead in the body can lead to poisoning.

Cobalt levels were detected in all the samples. The levels were low. Cobalt is not dangerous to some extent, since it is required or plant survival.

## 4 Conclusion

Trace metals such as copper, nickel, manganese, chromium, iron, lead, and cobalt were presented in all the samples analysed. The result revealed that Delta Glass Factory located around Ofuafor River is contributing to contamination of water bodies. The up take rate of chromium, iron, manganese copper and lead were high and they could constitute environmental hazards. With time, it will be dangerous to consume any fish from Ofuafor River. Since Glass Factory makes use of metal compounds as additives in the manufacturing of bottles and glasses and the effluent is discharged around the river, through runoff it will continue to pollute the river. Industries and factories are the polluter of our natural environment and waters.

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