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Trace Elements Concentrations in Water and Aquatic Biota from Ase Creek in Niger Delta

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ABSTRACT: Water, *Tilapia zilli, Synodontis nigrita, Clarias angillaris, Ipomoe cearri* and *Eichornnia natans* samples collected from Ase-creek for a period covering ten months (January – October, 2006). The aforementioned samples were analysed for heavy metals such as selenium, arsenic, chromium, lead, molybdenum, bismuth and cadmium using atomic absorption spectrophotometry (AAS) of model Pye Unicam 2900. The results obtained revealed that there were metal variations and elevated concentrations were obtained except for arsenic which was below detection limit in fish samples. These elevated metal concentrations determined indicate a deep pollution of the Ase-creek. Metal concentrations in the fish species and aquatic plants in this study are good indicators for environmental monitoring in Nigerian rivers. Oil explorations, industries and anthropogenic wastes were traceable to the elevated metal concentrations in the Ase-creek. @JASEM

KEYWORDS: Ase-creek, heavy metal pollution, metal variation, environmental monitoring, bioaccumulation.

The impact of man's action on the environment is on man. As man's activities affect the quality of the environment, so also the environment affects the quality of man's life (Horsfall and Spiff, 2001).

Metals tend to accumulate in animals and plants, sea grasses and mangrove vegetation (Prange and Dennison, 2000). The extent of metal uptake, toxicity and bioaccumulation varies depending on the organism. Accumulation of metals in aquatic organisms can be useful indicator of the presence of metals in biological available forms (Mortimer, 2000). Aquatic biotas were used as bioindicators for heavy metals pollution in water from Ebro River Spain. The primary sources of heavy metals in the river were traced to industrial activities along the basin (Mouvet, 1993). Toxic metals are available to biota from various sources of industrial effluents (Gamila and Naglaa, 1999). High concentrations of heavy metals have been reported in tissues of adult cory's shearwater from Mediterranean and Salvage islands (Renzoni *et al*., 1986). The concentrations of dissolved and particulate trace metals and the main features of their distributions gave useful information about the sources of metals in a small tidal Mediterranean bay (Dassenakis *et al*., 1996).

Cadmium is not a biologically essential or beneficial element, but is associated with various deleterious effects. All forms of life, particularly crops, are potentially threatened by cadmium (Prater, 1995). Cadmium is a teratogen, carcinogen, and a possible mutagen (Eisler, 1985). Freshwater biota is the most sensitive to cadmium; marine organisms are less sensitive than freshwater organisms and mammals and birds are comparatively resistant to cadmium (Eisler, 1985). The indiscriminate disposal of the industrial as well as the domestic wastewaters has posed a perennial problem resulting in the gross pollution of the Ganges River (Ajal *et al*., 1987). The various oil well oil locations and constant oil spillage were attributed to sediments and vegetations contamination (Nwajei, 2002). High levels of cadmium accumulation were found in the three parts of fish body. The presence of cadmium is as a result of industrial pollution in Asaba and Onitsha areas of the River Niger (Nwajei and Oruvwuje, 2001). Environmental pollution by industrial wastes has become a threat to the continued existence of plants and animals and may ultimately threaten the quality of human life. Lead wastes washed into water bodies accumulate in aquatic biomass; they are concentrated and passed up the food chain to human consumers. Lead is known to damage the brain, the central nervous system, kidneys, liver and the reproductive system (Aderemoti, 1996). The distribution of an element in biological samples collected from an ecosystem can be equally complex. In plants for example, the distribution of minor elements or particular species is not uniform throughout the whole organism (Ure and Davidson, 1997). Stinson and Eaton (1983) found that the whole body lead in male crayfish was significantly greater than that of female crayfish. The same relationship was reflected in muscle lead and in exoskeleton lead. As reviewed, there is evidence that cadmium accumulates in the tissues of seaweeds, crustaceans, polychaete worms and molluscs from water containing cadmium at concentrations ranging from trace amounts to less than 0.0005 mgCd/L, although uptake rates are low (McLease, 1980). Ase creek is located in the Niger Delta. There are extensive oil exploration activities by various oil companies. The activities of oil companies around the creek will in no doubt contribute to water pollution; hence it became necessary to carry out this study. The objectives of

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this study, however are: to identify the sources of aquatic pollution by heavy metals and to determine the concentrations of heavy metals in water, fishes and aquatic plants.

MATERIALS AND METHOD

Ase creek in Asaba-Ase is located in Ndokwa East Local Government Area, Delta State of the Niger Delta region. All pollution load arising from the oil exploration and other human activities empties into the River Niger which is eventually received by the Atlantic Ocean.

Surface water, fishes and plants samples in Ase creek from Asaba-Ase were collected for the period covering May to November, 2005.

Surface water samples were collected with polypropylene sampling bottles and were filtered through pre-weight 0.45 µm Millipore membrane filters. All sample handling was carried out in a clean container. Dissolved trace metals were pre-concentrated and were eluted with 2M HNO_3 (Riley and Taylor, 1986; Scoullos and Dassenakis, 1984).

Fishes (*Tilapia zilli, Synodoutis nigrita* and *Clarias angillaris*) and aquatic plants (*Ipomoe cearri* and *Eichornnia natans*) were collected from Ase-Creek. The fishes and aquatic plants were taken to the Laboratory for possible identification. The fish samples were deserted with a clean stainless steel knife and were then oven-dried at 60^0C. The samples whole body were crushed in clean mortars with pestle and kept in the refrigerator prior to digestion. The aquatic plant samples were air-dried for about 24 hours. The samples were crushed and kept prior to digestion.

1.0 g of each sample was weighed and digested in acid mixture containing 20 mL HNO_3 and 5 mL $HClO_4$ (Adham *et al.,* 1999 and Zurera *et al.,* 1987). The resultant solutions were placed on hot plate (100^0C) with constant stirring before they were transferred into the fumehood for overnight. The digest was filtered after cooling and the filtrate was made up to 100 ml in a volumetric flask with deionized water. The solutions were stored in the refrigerator prior to metal analysis. All acids used in the above digestions were of analytical grade.

RESULTS AND DISCUSSION

The elemental concentrations obtained from the analysis of water, fishes and aquatic plants samples from Ase-Creek in the Niger Delta of Delta State are presented in Table I below. The results obtained revealed that arsenic levels were below detention for the fishes whereas they were present in water and aquatic plants. All the metals detected in various samples showed variations. Metal concentrations in water samples were lower than those obtained in fishes and aquatic plants. These elevated metal values in fishes and aquatic plants are attributed to bioaccumulation. This study has indicated that bioaccumulation of metals levels in *Tilapia zilli* and *Synodontis nigrita* are more than those levels found in *Clarias angillaris*. This implies that *Tilapia zilli* and *Synodontis nigrita* have higher rate of metal accumulation when compared with *Clarias angillaris*. This study has revealed that fishes are good bio accumulators of heavy metals and can be used as indicator for environmental monitoring.

Table 1: Mean, Standard Deviation and Range of Results of Heavy Metal Concentrations in Water (mg/L), Fishes and Plants in mg/kg dry weight (n = 10).

Sample Name	Se	As	Cr	Pb	Mo	Bi	Cd
Water	0.09±0.00 0.09-0.10	0.04±0.00 0.04-0.05	0.02±0.00 0.02-0.03	0.05±0.01 0.04-0.06	0.06±0.01 0.05-0.08	0.08±0.01 0.07-0.10	0.06±0.01 0.05-0.07
Water	0.08±0.02 0.06-0.10	0.03±0.01 0.01-0.04	0.03±0.01 0.02-0.04	0.05±0.01 0.04-0.06	0.07±0.01 0.05-0.08	0.08±0.02 0.06-0.09	0.05±0.01 0.04-0.06
Tilapia zilli	2.0±0.4 1.5-2.5	ND	1.0±0.4 0.5-1.5	1.0±0.2 0.8-1.0	1.3±0.2 1.0-1.5	1.8±0.2 1.5-2.1	1.0±0.1 0.8-1.1
Syndodontis nigrita	1.7±0.1 1.5-1.7	ND	1.0±0.2 0.8-1.2	1.0±0.1 0.9-1.1	0.9±0.2 0.7-1.1	1.2±0.2 1.0-1.4	0.8±0.2 0.6-0.9
Clarias angillaris	1.3±0.1 1.2-1.5	ND	0.8±0.2 0.6-1.0	0.6±0.1 0.5-0.9	0.8±0.2 0.6-0.9	1.0±0.2 0.7-1.3	0.6±0.1 0.5-0.7
Ipomoe cearri	2.3±0.2 2.1-2.6	0.5±0.2 0.3-0.7	1.0±0.2 0.7-1.3	0.8±0.1 0.6-0.9	1.4±0.2 1.1-1.7	1.5±0.2 1.3-1.8	1.0±0.3 0.6-1.4
Eichornia natans	1.0±0.1 0.8-1.1	0.5±0.1 0.4-0.7	0.6±0.1 0.5-0.7	0.5±0.2 0.3-0.7	0.8±0.2 0.5-1.0	1.2±0.2 1.0-1.4	1.3±0.3 1.0-1.5

ND= not detected

The mean concentrations of metals such as chromium (0.006 ppm), cadmium (0.002 ppm), and lead (0.017 ppm) obtained by Aiyesanmi (2006) in river waters, within Okitipupa Southeast belt of the Nigeria bitumen field were lower than those values obtained in this study. On the other hand, arsenic mean levels (0.300 and 0.283 ppm) exceeded those values obtained in this study. The chromium (0.06 ± 0.07 – 0.22 ± 0.21 mg/L) and lead levels (0.06 ± 0.07 – 0.11 ± 0.07 mg/L) obtained in water samples by Braide *et* *al.*(2004) from Miniweja, stream and a swamp forest stream receiving non-point source waste discharges in eastern Niger Delta were within the same levels obtained in this study. The concentrations of arsenic, cadmium, chromium, molybdenum and selenium obtained in this study were relatively within the same levels obtained by Ndiokwere *et al*. (1983) from Rivers Niger and Benue and Warri and Lagos harbours.

A close look at the mean metal concentrations in the two aquatic plants (*Ipomoe cearri* and *Eichornnia natans*) showed that *Ipomoe cearri* has relatively high metal levels when compared with those obtained in *Eichornnia natans*. This implies that *Ipomoe cearri* has higher rate of metal absorption except for arsenic. Metal concentrations in the aquatic plants in this study exceeded those obtained by Nwajei and Oruvwuje (2001) in Nymphaea lotus from River Niger. Mean metal concentrations in water, fishes and aquatic plants are an indication that Ase-Creek is polluted. Oil exploration, activities, industrial activities and anthropogenic waste could account for these relatively high trace metal concentrations in Ase-Creek. Heavy metal poisoning is a notorious problem to both developed and developing nations. The consumption of fishes from the Ase-Creek could lead to heavy metal poisoning.

Conclusion: The heavy metal analysis in water, fishes and aquatic plants studied for this period indicated pollution. There were metal variations in the monthly assessment. The results obtained also revealed that the heavy metal concentrations were elevated. The concentrations of metals obtained were compared with values obtained by researchers in similar studies. Metal concentrations in the fish species and aquatic plants in this study are a good indicator for monitoring pollution in Nigerian rivers. These elevated values of selenium, arsenic, chromium, lead, molybdenum, bismuth and cadmium were traceable to oil exploration activities, industries and anthropogenic wastes.

REFERENCES

Ademoroti, C.M.A. (1996). Environmental Chemistry and Toxicology. First edition, Foludex Press Limited, Ibadan. p. 80.

Adham, K.G., Hassan, I.F., Taha, N. And Amin, T. (1999). Impact of hazardous exposure to metals in the Nile and Delta Lakes on the Catfish, *Clarias lazera. Environ. Monit. Asses,* **54**(1):107 – 124.

Aiyesanmi, A.F. (2006). Baseline concentrations of heavy metals in water samples from rivers within Okitipupa Southeast Belt of the Nigerian Bitumen Field. *J. Chem. Soc.* **31**(1and2): 30 – 37.

Ajmal, M., Khan, M.A. and Nomani, A.A. (1987). Monitoring of Heavy Metals in the Water and Sediments of the Ganges River. *Water Sci. Technol.* **19**(9), 107 – 117.

Braide, S.A., Izonfun, W.A.I., Adiukwu, P.U., Chindah, A.C. and Obunwo, C.C. (2004). Water quality of Miniweja Stream, A Swamp Forest Stream Receiving Non-Point Source Waste Discharges in Eastern Niger Delta, Nigeria. *Scientia Africana*, **3**(1):1-8.

Dassenakis, M.I., Kloukiniotou, M.A. and Pavlidou, A.S. (1996). The influence of Long Existing Pollution on Trace Metal Levels in a Small Tidal Mediterranean Bay. *Mar. Pollut. Bull.* **32**(3): 275 – 282.

Eisler, R. (1985). Cadmium hazards to fish, wildlife, and invertebrates: a synoptic review, US Fish and Wildlife Service. *Biol. Rep.* **85**(1, 2), Washington, D.C.

Gamila, H.A. and Naglaa, F.A. (1999). Estimation of the hazard concentration of industrial wastewater using algae bioassay. *Bull. Environ. Contam. Toxicol.* **63**: 407 – 414.

Horsfall, M. Jr. and Spiff, A.I. (2001). Principles of Environmental Pollution. First Edition, Metroprints Limited, Port Harcourt, Nigeria. Pp. 20 – 19.

McLease, D.W. (1980). Uptake and excretion of cadmium by marine organism from sea water with cadmium at low concentrations. *Canadian Technical Report of Fisheries and Aquatic Sciences.*

Mouvet, C. (1993). Aquatic mosses for the detection and follow-up of accidental discharges in surface water. *Wat. Air Soil Pollut*. **67**:333-347.

Ndiokwere, C.L. (1983). Determination of some Toxic Trace Metals in Nigerian River and Harbour Water Samples. *J. Radio-analytical Chemistry*, **79**(1): 147 – 151.

Nwajei, G. E. (2002) Heavy Metal Concentration in Marine Sediments and Vegetation from River Ramos in Bayelsa and Delta State of Nigeria. *Pak. J. Sci. Ind. Res.* **45**(2):111 - 113.

Nwajei, G.E. and Oruvwuje, J.U. (2001). Assessment of Heavy Metals in *Clarias buthopogon* (Fish) parts and *Nymphaea lotus* (Aquatic plant) in River Nigeria, Delta State of Nigeria. *Pak. J. Sci. Ind. Res.* **44**(6):333 – 337.

Prange, J.A. and Dennison, W.C. (2000). Physiological responses of five seagrass species to trace metals. *Mar. Pollut. Bull.* **41**(7-12), 327 – 336.

Prater, J.C. (1995). Environmental contaminant reference databook. Vol. 1, Van Nostrand Reinhold, New York.

Renzoni, A., Focardi, S. and Fossi, C. (1986). Comparison between the concentration of mercury and other contaminants in eggs and tissues of cory's shearing water islands. *Environ. Pollut.***(A)**4: 17 – 35.

Riley, J.P. and Taylor, D. (1986). Chelating resins for the concentrations of trace elements from Seawater and their analytical use in conjunction with AAS. *Anal. Chem. Acta.* **40**, 479 – 484.

Scoullos, M. and Dassenakis, M. (1984). Determination of dissolved metals in Seawater, using the resins Chelex-100; In Proceedings of the 1st Greek Symposium on Oceanography and Fishers. Pp. 302 – 309, National Centre for Marine Research.

Stinson, M.D. and Eaton, D.L. (1983). Concentrations of Lead, Cadmium, Mercury, and Copper in the Crayfish (*Pacifasticus leninsculus)* obtained from a Lake Receiving Urban Runoff. *Arch. Environ. Contam. Tixicol.* **12**, 693-700.

Ure, A.M. and Davidson, C.M. (1997). Chemical Speciation in the Environment. Blackie A and P, New York. Pp. 9 – 20.

Zurera, G., Estrada, B., Rincon, R. and Poto, E. (1987). Lead and Cadmium contamination levels in edible vegetables. *Bull. Environ. Contamin. Toxicol.* **38**:805 – 812.