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ASSESSMENT OF HEAVY METALS IN *CLARINS BUTHOPOGON* (FISH) PARTS AND *NYMPHAEA LOTUS* (AQUATIC PLANT) IN RIVER NIGER, DELTA STATE OF NIGERIA

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River Niger, the largest river in Nigeria flows southwards across Asaba and Onitsha to the Delta areas. The *clarins buthopogon* (fish) and *Nymphaea lotus* (aquatic plant) from the River Niger at Asaba were sampled for analysis using Atomic Absorption Spectrophotometer (AAS). The concentration of the heavy metals from the three parts of the fish (head, muscle and tail) had the following ranges: Cr, 8.90-9.70; Cu, 2.90-3.90; Fe, 6.00-113.20; Mg, 138.00-3398; Ni, 5.48-14.68; Pb, 0.20-1.60; Hg, 0.38-2.00 and Cd, 1.41-1.78 mg kg^{-1} on dry weight basis. These values were higher than those obtained in Kaduna River and Mediterranean coaster waters. The concentrations in *Nymphaea Lotus* (aquatic plant) were extremely high (Cr, 20.30; Cu, 10.70; Fe, 569.20; Mg, 6798.00; Ni, 72.08; Pb, 6.00; Hg, 51.30 and Cd, 31.10 mg kg^{-1} dry weight) and were also higher than those of fish part. The bioaccumulation of heavy metals in fish parts and aquatic plant indicated pollution, as per WHO and FEPA standards for aquatic life.

Key words: Industrial pollutants, Water contamination, Metal accumulation, Fish, Aquatic plants, River Niger.

Introduction

River Niger is the largest river in Nigeria. The source of the River Niger is situated in West Africa. It flows southwards across Asaba and Onitsha to the Delta areas and finally empties into the Atlantic Ocean.

Recently Nnabuife (2001) has indicated that about 97% of the plant's liquid freshwater which stored in underground aquifers faces the danger of contamination by heavy metals, pesticides and industrial chemicals. All industrial wastes when not handled according to the World Health Organization's (WHO) regulation, create many problems (WHO, 1991). The coastal area of Nigeria is exposed to industrial and domestic wastes flushed from hinterland (Nwajei 1994).

Pollution from depth charges during seismic activities at the exploration stage, deck drainage gas flaring, debilitating effect of oil tankers, effluent discharge at the refining stage render waters for human consumption domestic use and fishing (Ajomo 1990). Aquatic habitat degradation can result from any action that alters the physical and chemical attributes of a stream or river thus reducing utilisations by biota (Charles 1992). Changes taking place at the molecular level in fish can provide an early warning that pollution is reaching harmful levels (Charles 1992). The ranges of total mercury concentrations found in Zebra muscles from the upper Mississippi River (UMR) (0.02-0.05μg g^{-1} dry weight are similar to that inhabiting other North American and European rivers (0.05-0.38μg g^{-1} dry weight) contaminated by human activities (Secor *et al* 1993; Camusso *et al* 1994). The UMR is contaminated by a variety of chemicals originating from point and nonpoint sources (Wiener *et al* 1994). Mercury, cadmium and polychlorinated biphenyls are persistant toxic substances with no known essential biological function and the most hazardous contaminants released into the river (Rada *et al* 1990; Cope *et al* 1994). Fish and invertebrates inhabiting the river contain elevated concentrations of mercury, cadmium and polychlorinated biphenyls (Dukerschein *et al* 1992; Beavals *et al* 1994; Steingraeber *et al* 1994) but the contribution of historically contaminated sediments to contaminant burdens in biota relative to present inputs, is known.

Many inorganic compounds can accumulate in plants and this may lead to toxic effects in animals and humans (Dinman 1972). Residues are strongly influenced by industrial contamination and land urban runoff. In recent times, however, decrease in the quantity and variation of fish species has raised concern on the health of the Gulf of Guinea and the sustainable development in the countries around the gulf (Maduka 1998). The contamination of fish and wildlife in the lower Colorado River has been observed as a result of movement form sediment or illegal use of DDT or DDE (White and Krynitsky 1986). The oil spillage in Niger Delta (1980), which destroyed crops on the River Basin or banks. Usually the oil spill destroy the aquatic life of the oceans including the food of fishes and shellfish.

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Asaba and Onitsha are two urban towns that are heavily industrialised. It was therefore, thought necessary to asses the impact of industrial pollution by determining the levels of trace metals and their effects in fish and on aquatic plants.

Materials and Methods

Samples of fish and aquatic plant were collected from River Niger at Asaba, taken to the laboratory for identification and were preserved in refrigerator. Both the fish and plant were dried in oven at about 105°C and then crushed in mortar with pestle.

Four samples of the same species of fish and aquatic plants were collected. Sixteen samples were analysed in all. The fish were cut into three parts namely the head, muscle and tail.

Samples of both fish and plants (5.0 g each) were digested in acid mixture (HNO_3 and H_2SO_4) of equal ratio (15 ml:15 ml). They were kept on hot plates for about 30min until nitrous oxid gas was evolved, then transferred to the fume cupbound where digestion lasted for 3 h. The digests were allowed to cool and then filtered. The filtrates were made up to 100 ml in each case with deionized water. Hg and Cd were determined with Atomic Absorption Spectrophotometry (AAS) of model:spectra AA-10 varian whereas Cr, Cu, Fe, Mg, Ni and Pb were determined with Perkin - Elmer - 3110 model.

Results and Discussion

Table 1 below represents the uptake of trace elements, mg kg^{-1} and [95% confidence limit (n=4)] in *Clarins Buthopogon* and *Nymphaea Lotus* (Aquatic plant).

The chromium (Cr) accumulation levels in the fish parts were in the decending order: head>tail> muscle. It exceeded the limits of World Health Organisation (WHO) and Federal Environmental protection agency, FEPA (WHO 1986) standards for aquatic life. The bio accumulation of Cr levels in the parts of the fish may be attributed to industrial activities located in Onitsha and Asaba. Wastes and effluents from

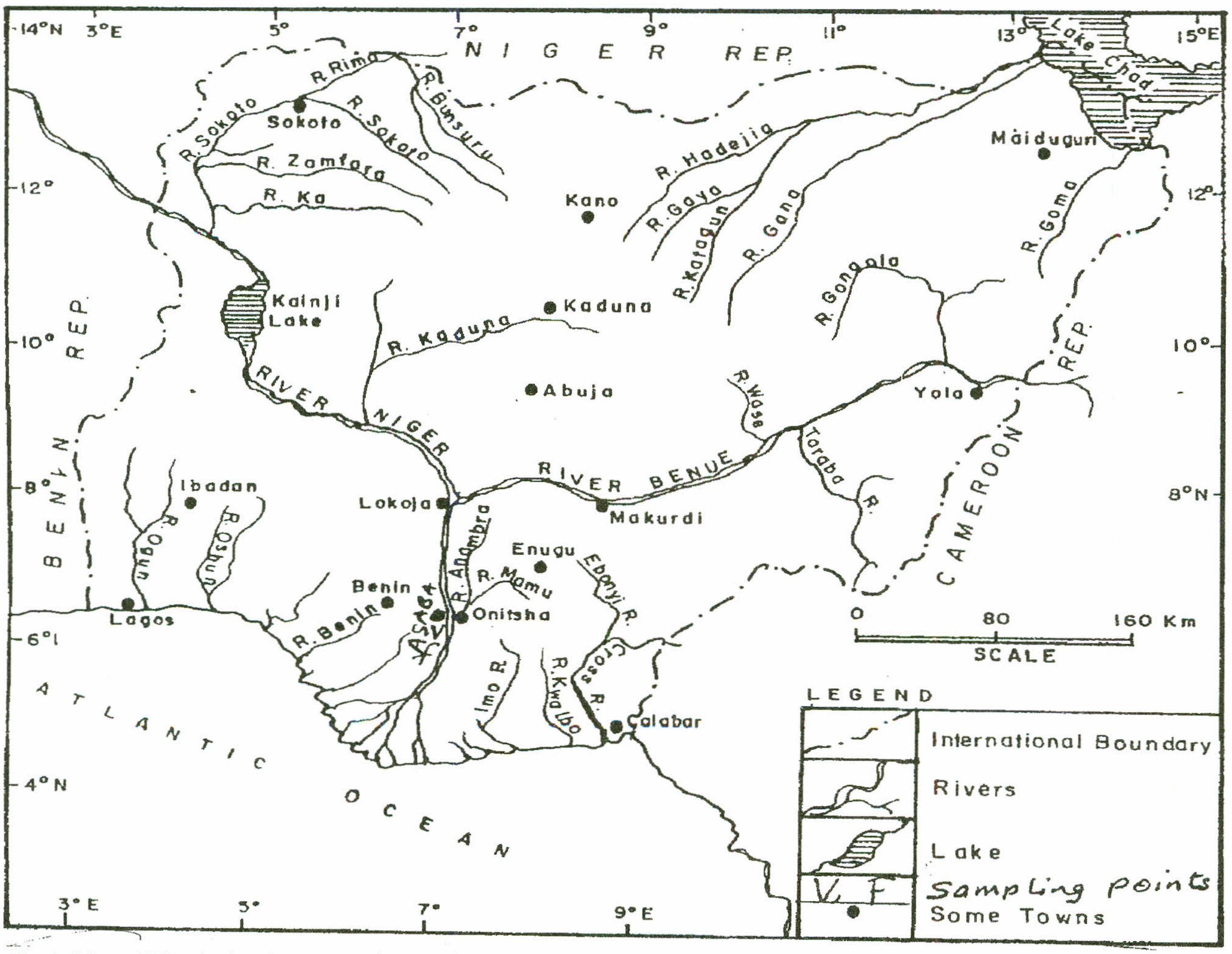

Fig 1. Map of Nigeria showing some Rivers and Lakes and Sampling Points

textile mills, breweries, metal construction companies market enviornment etc are considered as polluters to River Niger.

The bioaccumulation of Cu in fish may not be only attributed to industries around the sample point, most pollutents also to come from the upstream of the river. The mean copper (Cu) levels obtained in head and tail of fish were the same and higher than that of the muscle. These levels were high than the permissible limit of FEPA (0.05 mg l^{-1}).

The presence of Fe may be as a result of metal works in Onitsha and Asaba. The mean levels of iron (Fe) obtained in parts of the body of fish revealed that the bioaccumula tion of Fe was highest in the tail, followed by the muscle they exceeded those obtained in the bodies of *Lates nilofious* (5.15 mg kg^{-1}) and *Momyrus rume* (2.35 mg kg^{-1}) from Kaduna River.

Magnesium (Mg) levels in the parts of the body of fish were extremely high and were in the order: head>muscle> tail. The high levels of Mg in body of fish may be due to hardness of the River Niger Water. River Niger is being fed by rivers and streams and hence receiving all the pollution loads from streams and rivers from upstream.

Ni level is highest in the fish head, followed by the muscle and in the tail. These levels exceeded the WHO and FEPA limits.

The highest level of lead (Pb) was obtained in the muscle of fish, however the level in the head exceeded that in the tail. The mean levels of Pb in the muscle and head of the fish were higher than those obtained in *Synodoritis membranceous* (0.56 mg kg^{-1}), *Hyperopsus bebe* (0.56 mg kg^{-1}), *Labeo cabic* (0.94 mg kg^{-1}) and *Monyrus rume* (0.57 mg kg^{-1}) from Kaduna River (Nwaedozie 1998). The accumulation levels of Pb in three parts of the fish studied were higher than 1.7 μg^{-1} which is the maximum allowable limit and the maximum accept-

Table 1

Trace elements in *Clarins buthopogon* in mg kg^{-1}

Sample	Cr	Cu	Fe	Mg	Ni	Pb	Hg	Cd
Head	9.60	3.60	6.00	3397.00	14.28	0.80	1.99	1.78
	9.75	4.20	5.60	3397.70	14.68	1.20	2.01	1.78
	9.80	3.76	6.40	3398.30	14.20	0.96	1.95	1.68
	9.65	4.04	6.00	3399.00	14.76	1.04	2.05	1.88
Mean	9.70± 0.58	3.90± 0.43	6.00± 0.52	3398.00± 1.35624	14.48± 0.447	1.00± 0.27	2.00± 0.07	1.88± 0.13
Muscle	8.80	2.70	107.00	178.00	14.60	1.60	1.90	1.50
	9.00	3.10	107.40	178.00	14.76	1.60	2.02	1.60
	8.90	2.98	107.20	178.50	14.50	1.50	1.94	1.70
	8.90	2.82	107.20	178.50	14.86	1.70	1.98	1.60
Mean	8.90± 0.13	2.90± 0.23	107.20± 0.2598	178.00± 0.6495	14.68± 0.256	1.60± 0.13	1.96± 0.08	1.60± 0.13
Tail	9.30	3.90	112.90	137.80	5.40	0.02	0.36	1.31
	9.30	3.90	113.00	138.20	5.53	0.01	0.40	1.51
	9.18	3.89	113.40	138.00	5.43	0.02	0.39	1.39
	9.42	3.91	1113.50	138.00	5.56	0.03	0.37	1.43
Mean	9.30± 0.36	3.90± 0.01	113.20± 0.4684	138.00± 0.2598	5.48± 0.12	0.02± 0.03	0.38± 0.03	1.41± 0.13
Aquatic Plant	20.10	10.70	568.99	6797.90	71.99	5.68	51.00	31.00
	20.50	10.70	569.41	6798.10	72.17	6.32	51.60	31.20
	20.29	10.50	569.00	6797.50	72.00	6.00	50.99	30.98
	20.31	10.90	569.40	6798.50	72.16	6.00	51.61	31.22
	20.30± 0.260	10.70± 0.260	569.20± 0.3767	6798.00± 0.66239	72.08± 0.156	6.00± 0.42	51.30± 0.560	31.10± 0.203

able limit of FEPA and WHO respectively. The elevated levels of Pb may be attributed to activities of paint industries in Onitsha and it's environs. Thus consumption of fishes from River Niger will lead to Pb poisoning, since level above 0.05 mg kg^{-1} in food is dangerous (Nwaedozie 1998).

The levels of mercury in the head is more than those of the muscle and tail. The high concentration of Hg in fish parts may be due to the fact that Onitsha area is polluted by industrial wastes. These levels exceeded the USEPA limit for freshwater aquatic life which is 0.0041 ppm (ACS, 1993) and also exceeded (0.005 mg kg^{-1}) the maximum tolerable intake of total mercury (0.005 mg kg^{-1}) in food (Vettorazzi 1982). In a similar work done in Kaduna River, Hg was below detection limit in all the fish analysed (Nwaedozie 1998).

High levels of Cd accumulation were found in the three parts of fish body. The presence of Cd is a result of industrial pollution in Asaba and Onitsha areas of the River Niger. Levels of Cd in the parts of fish body exceeded those obtained in *Sardinella aurita* is (0.6mg kg^{-1}), *Saurida undosquamis* (0.3mg kg^{-1}) and *Upeneus moluccensis* (0.3mg kg^{-1}) from Mediterranean costal waters of Israel (Hornung 1977). These values also exceeded the limits of WHO and FEPA (0.03 mg kg^{-1}). The consumption of fishes from River Niger may be dangerous to human health.

Nymphaea lotus (aquatic plant). The determination of Cr, Cu, Fe, Mg, Ni, Pb, Hg and Cd in aquatic plant revealed that bioaccumulation of these metals was highly elevated. Plants being immobile are particularly vulnerable to poisoning by heavy metals. (Kneer and Zenk 1993). However higher plants protect themselves against toxic heavy metal ions by using specialised molecules to trap and inactivate the ions. This may be the reason of higher bioaccumulation of trace metals in aquatic plant than those of the parts of fish body. The fish swims away from pollution points while the aquatic plants remain immobile.

The highest levels of Mg were obtained from both fish parts and aquatic plant. However, Mg is not known to be critical metal, instead it is needed in plants growth.

The polluters of River Niger are numerous, since it originates from West Africa (upstream to the downstream) then flows down stream through Onitsha and Asaba environs, all industrial effluents and wastes are discharged into it.

Conclusion

The mean levels of heavy metals in aquatic plant exceeded those of the parts of fish body. The concentrations of heavy metals in parts of fish body of Niger River also exceeded those concentration values obtained from the fish of Kaduna River and Mediterranean coaster waters. The levels of trace metals were also higher than the WHO and FEPA limits for aquatic life. These elevated levels of trace metals are attributed to industrial activities in the upstream along River Niger, Onitsha and Asaba environs. Such industries include textile mills, bre-weries, metal works, paint industries, saw mills, chemical industries etc.

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