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Comparative study of heavy metals concentration in some water bodies of EKET and NSIT Ubium local government area of Akwa Ibom state, Nigeria

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ABSTRACT

A study of the heavy metals concentration in some water bodies of Nsit Ubium and Eket local government area of Akwa Ibom State was investigated between June and December 2012. Surface water from six rivers located in different parts of the two local government area was collected and analysed for the presence of heavy metals. The following range of values were obtained, Iron (Fe) 0.82±2.10 - 87±2.04 mg/l, Manganese (Mn) 0.22±1.21 - 0.37±1.24 mg/l, Copper (Cu) 0.13±0.71 - 0.25±0.68 m g/l, Zinc (Zn) 0.31±0.61 - 0.37±0.61 mg/l, Cobalt (Co) 0.02±0.01 - 0.04±0.01 mg/l, Nickel (Ni) 0.42±0.32 - 0.52±0.31 mg/l in Eket LGA while in Nsit Ubium, Iron (Fe) ranged between 1.11±0.90 - 1.20±1.90 mg/l, Manganes e (Mn) 0.18±0.01 - 0.27±0.01 mg/l, Copper (Cu) 0.03 ±0.21 - 0.42±0.28 mg/l, Zinc (Zn) 0.21±0.028 - 0.27±0.034mg /l, Cobalt (Co) 0.01±0.01 - 0.02±0.01 mg/l, Nickel (Ni) 0.54±0.01 - 0.64±0.01 mg/l respectively. The concen trations of the various heavy metals falls within the recommended values World Health Organization standards for drinking water. However, Iron and copper were above the WHO recommended safe level. This shows that water bodies around Eket were more polluted with heavy metals (Iron and copper) than water bodies in Nsit Ubium. Thus water from the investigated rivers in Eket area is not safe for portability. However, it can be treated to enhance its use for portability and for other domestic purposes.

Keywords: Heavy metals, drinking water, load

INTRODUCTION

The increasing nutrient in river is attributed to many biological processes such as organic break down of large macromolecules into their component elements. This has been a constant source of nutrient in aquatic ecosystem and it is useful for growth of aquatic plants. Nitrates and phosphates has been reported to be a product of surface runoffs from the surrounding water sheds farms, forest liters and domestic waste from homes (Ihenyen and Aghimien ,2002; Kazier and Adaipkoh, 2007; and Karade *et al*., 2007). Aquatic ecosystem has been exposed to varying degree of pollution from anthropogenic activities. Soil erosion is closely linked with high surface runoffs and rapid siltation of surface water system which results in subsequent decline in its portability (Ikomi and Emuh, 2000). The constant washing of the top soils across polluted land has lead to high levels of nutrients materials in water bodies receiving them. Mining, oil exploration activities, manufacturing and agricultural practices, domestic and commercial practices has been reported to generate high waste with considerable amount of heavy metals (Egbore, 1991). Heavy metals have been reported in refinery waste and industrial effluents (Osuji and Onojake, 2004). Within a given concentration, river systems bear with them mineral deposits which are byproducts of processes operating within that aquatic environment (Kaizer and Osakwe, 2010).

Heavy metal toxicity in rivers is a major concern for portability and dairy industries that use large volume of water. Heavy metal concentration in rivers may vary from one station to another and from rivers to rivers and also from water column and sediments (Oribhabor and Ogbeibu, 2009). This variation in concentration of heavy metals in principally due to different processes operating within the given station or river (Omoigberale and Ogbeibu, 2005).

Several workers have investigated the concentration of heavy metals in the aquatic ecosystem, these include those of Edema (1993), Ntekim et al., (1993). This work is therefore aimed at studying the heavy metal concentration in some rivers in Nsit Ubium and Eket LGA area of Akwa Ibom State with a view of accessing the effects of oil exploration on the quality of rivers. It is hoped that the research findings would help in assessing the contaminant status of the various rivers with an overall interest in improving surface water quality within the oil producing area of Akwa Ibom State.

MATERIALS AND METHODS

Description of study sites

The studiedrivers are located in Akwa Ibom State, Nigeria (longitude 7°E - 30°E and latitude 4°55°N - 4°58°N) in the south oil rich region of the Niger Delta. Six rivers were selected for sampling within two local government area of the state (Eket and Nsit Ubium) due to their location within the oil exploration zone. They are: Ndukposi, Ikot Udo Ide and Ikot Ekpo Udo in Nsit Ubium LGA and Afaha Eket, Atabong Eket and Idua Eket in Eket LGA. The climate of the study area is humid tropical with annual rainfall varying from 250mm to 300mm with 1-3 dry months in a year. Mean annual temperature varies between 26°- 28°C with relative humidity of 75-80%. The prime occupation of the local settlers is farming. The presence of oil exploration activities by Exxon-Mobil and other service companies in the studied area influences activities both downstream and upstream.

Samples Collection and Analysis

Water samples were collected from water surfaces from the six rivers monthly for a period of six months in triplicate from June to December 2011. The water samples were collected from the same points of the river during the entire sampling period. Triplicate samples were collected at the same point in clean 1 litre containers and labeled accordingly. Water sample description revealing sample condition at the time of sampling was also noted. Samples were stabilized by addition of concentrated trioxonitrate V acid (HNO_3). This was done to retard biological action, hydrolysis of some chemical compounds and to reduce volatility of some chemical constitutes. They were stored in ice packed coolers and preserved at a temperature of 40°C before transportation to the laboratory for analysis. This was carried out in order to ensure that no significant changes in composition of samples occurred before the analysis was carried out in the laboratory. All analysis were carried out in accordance with International Standard Methods (APHA, 1995) and expressed in mg/l.

Preparation of Standard Solutions: One gram of the pure metal was dissolved in 20ml of HCl and diluted in 1 litre mark of a volumetric flask with de-ionised water to give 100mg/l of the metal stock solution. This process was repeated for all the metals analysed. Several solutions of concentrations 4.00mg/l, 6.00mg/l and 8.00mg/l were prepared from the stock solution by several dilutions as described by APHA (1995). Heavy metals analyses were carried out with the aid of the Parkinson absorption spectrometer model 403 using required lamps.

RESULTS AND DISCUSSION

The result of heavy metal concentrations analyses carried out on the water samples collected from the investigated rivers within the studied area shown in table 1 and 2.

Table 1 shows heavy metal concentration of surface water of rivers in Nsit Ubium LGA (Ndukposi, Ikot Udo Ide and Ikot Ekpo Udo). Mn recorded the highest with 0.27±0.01 at Ikot Udo Ide and theleast with 0.18±0.01 at Ikot Ekpo udo. Cu was highest with 0.42±0.28 at Ikot Ekpo Udo and least with 0.03±0.21 at Ndukposi. Zn was highest in Ikot Ekpo Udo with a concentration of 0.27±0.034 and least in Ndukposi with 0.21±0.028. Co recorded highest with 0.02±0.01 at Ikot Udo Ide and the other two rivers(Ndukposi and Ikot Ekpo Udo had a concentration of 0.01±0.01. Fe was highest at Ndukposi with a concentration of 1.20±1.90 and Ikot Ekpo Udo had least with 1.18±0.84. Ni recorded the highest at Ndukposi with 0.64±0.01 and least in Ikot Ekpo Udo with 0.54±0.01. Concentrations of zinc, copper, iron, nickel, manganese and cobalt were found in Nsit Ubium Rivers in the order Ni>Mn>Zn>Fe>Cu>Co

for Ndukposi River, Ni>Mn>Zn>Cu>Fe>Co for Ikot Udo Ide River and Ni>Cu>Zn>Mn>Fe>Co in Ikot Ekpo Udo River.

Table 2 shows heavy metal concentration of surface water of rivers in Eket LGA (Afaha Eket, Atabong Eket, Idua Eket). Mn recorded the highest with 0.37±1.24 at Idua Eket and the least with 0.22±1.21 at Atabong Eket. Cu was highest with 0.25±0.68 at Atabong Eket and least with 0.13±0.71 at Afaha Eket. Zn was highest at Atabong Eket with a concentration of 0.37±0.61 and least in Afaha Eket with 0.31±0.61. Co recorded highest with 0.04±0.01 at Idua Eket and the least was observed at Afaha Eket with 0.02±0.01. Fe was highest at Atabong Eket with a concentration of 0.87±2.04 and Afaha Eket had least with 0.82±2.10. Ni recorded the highest at Idua Eket with 0.52±0.32 and least in Afaha Eket with 0.0.42±0.32.

The high content of these parameters in the water samples of the studied area could be attributed to anthropogenic activities in these areas. The high content of Cu in the studied area could be attributed to corrosion of water pipes made of copper, domestic and industrial wastes, as well as agricultural activities (fungicides). Crude oil spills couldalso contribute to the higher copper constituent in the rivers around Eket since Cu is a constituent of crude oil.

Relative to other rivers studied, elevated concentrations of zinc, copper, iron, nickel, manganese and cobalt were found in the Eket rivers in the order Fe>Ni>Zn>Mn>Cu>Co for Afaha Eket River, Fe>Ni>Zn>Cu>Mn>Co for Atabong River, Fe>Ni>Mn>Zn>Cu>Co for Idua Eket River,this findings is in contrast to that reported for Buguma Creek by Oribhabor and Ogbeibu (2009).Generally, metal concentration in Nsit Ubium Rivers was smaller in magnitude unlike areas in Eket. This could also be attributed to high population of oil exploration activities, increased refinery effluent and higher commercial activities. A further comparison of the heavy metal load in the various rivers shows that metal concentrations in rivers in Nsit Ubium were generally low (Table 1). However, there are indications of increasing stress conditions due to occurrence of high iron and copper content in the rivers. This finding is corroborated with the findings of Kaizer and Osakwe (2010) who reported a relationship between the amount of heavy metal concentration and the anthropogenic activities such as the combustion of fuel by oil installations and automobiles, as well as domestic activities prevailing in that ecosystem. Comparing the heavy metal load in the various water samples and WHO standards on portability, reveals an increasing trend for all rivers sampled. This shows an increasing pattern and could be due to crude oilimpact and associated waste and effluent and could be of health concern to its direct use for domestic without treatment.

TABLE 1. Heavy metals concentration of surface water of rivers in NSIT Ubium local government areas

Heavy metals (mg/l)	Ndukposi (ND)	Ikot Udo Ide(IKU)	Ikot Ekpo Udo(IKE)
Mn	0.24±0.01	0.27±0.01	0.18±0.01
Cu	0.03±0.211	0.12±0.23	0.42±0.28
Zn	0.21±0.028	0.24±0.03	0.27±0.034
Co	0.01±0.01	0.02±0.01	0.01±0.01
Fe	1.20±1.90	1.11±0.90	1.18±0.84
Ni	0.64±0.01	0.60±0.01	0.54±0.01

TABLE 2. Heavy metals concentration of surface water of rivers in Eket local government areas

Heavy metals (mg/l)	Afaha Eket(AE)	Atabong Eket(ABE)	Idua Eket(IE)
Mn	0.28±1.23	0.22±1.22	0.37±1.24
Cu	0.13±0.71	0.25±0.68	0.15±0.81
Zn	0.31±0.61	0.37±0.61	0.347±0.620
Co	0.02±0.01	0.03±0.01	0.04±0.01
Fe	0.82±2.10	0.87±2.04	0.83±2.09
Ni	0.42±0.32	0.48±0.31	0.52±0.32

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