Heavy Metal Concentration in Water, Sediment and Tissues of *Eichhornia crassipes* from Kolo Creek, Niger Delta

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Heavy Metal Concentration in Water, Sediment and Tissues of *Eichhornia crassipes* from Kolo Creek, Niger Delta

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ABSTRACT

This study evaluated the level of some heavy metals in water, sediment and *Eichhornia crassipes* from Kolo creek, Niger Delta, Nigeria. Triplicate samples were collected from three locations. The samples were processed and analyzed following standard procedures. Results showed that the concentration of lead, cadmium, iron, manganese, mercury and copper ranged from 0.001 – 0.002 mg/l, 0.001 – 0.001 mg/l, 0.137 – 0.157 mg/l, 0.013 – 0.017 mg/l, 0.000 – 0.001 mg/l and 0.019 – 0.114 mg/l respectively for water, 1.676 – 1.757 mg/kg, 0.137 – 0.147 mg/kg, 3.020 – 3.810 mg/kg, 0.407 – 0.490 mg/kg, 0.011 – 0.023 mg/kg and 0.365 – 0.782 mg/kg respectively for sediment. Furthermore, the level of heavy metals in the *Eichhornia crassipes* ranged from 0.002 – 0.003 mg/kg, 0.003 – 0.004 mg/kg, 0.000 – 0.004 mg/kg and 0.040 – 0.048 mg/kg for lead, cadmium, mercury and copper respectively. Statistically, there was no significant variation ($P>0.05$) among the various locations in majority of the heavy metals analyzed. The heavy metal concentration in water was below the permissible limit for heavy metal in potable water as specified by World Health Organization and Standard Organization of Nigeria. The concentration of heavy metals were low in water and *Eichhornia crassipes* suggesting that Kolo creek is not contaminated by heavy metals. However, the heavy metal were in the order *Eichhornia crassipes*< water sample< sediment.

Keywords: *Eichhornia crassipes*, Kolo creek, Water and sediment quality.

1.0 INTRODUCTION

Water is one of the most vital resources required by living organisms to thrive on (Agedah *et al.*, 2015; Izah and Srivastav, 2015). In addition, water is a habitat to several organisms. Some of these include aquatic reptiles, snakes, birds, mammals etc. Nigeria has several water resources including surface and ground water (Izah and Srivastav, 2015; Izah and Ineyougha, 2015; Izah *et al.*, 2016; Seiyaboh *et al.*, 2017a, b). Nigerian surface water resources include fresh water (river, stream, pond, lakes, creek, creeklets), brackish/estuaries (salt and fresh water interphase) and marine (salt water) (Izah *et al.*, 2016; Agedah *et al.*, 2015; Izah and Srivastav, 2015; Ogamba *et al.*, 2015 a-c; Seiyaboh *et al.*, 2017b).

Surface water usually has sediment and they play vital roles for the aquatic ecosystem (Seiyaboh *et al.*, 2017b; Ansa and Francis, 2007). Typically, benthic organisms reside in the sediment especially in the brackish and marine ecosystems. Some fish species also thrive on the sediment especially shelled fish. Water sediment exists in two forms including suspended and deposited sediment (Seiyaboh *et al.*, 2017b). Irrespective of the type of sediment, they are affected by the water quality. For instance, changes in water quality arising from anthropogenic activities in the water such as water transportation, dredging, waste deposition and natural effects resulting from runoff following precipitation can also affect the sediment quality. Furthermore, sediments also result from weathering processes of substances/materials which are transported by several actions including wind and water. As such sediment is predisposed to pollution just as water (Seiyaboh *et al.*, 2017b). Like sand, the particulate size of sediment are in different categories including loose sand, clay, silt, and other soil particles that are found in water sediment.

The Niger Delta of Nigeria has several fresh water bodies. For instance, in Bayelsa state several rivers, ponds, lakes and creeks exist including River Nun (Agedah *et al.*, 2015; Ogamba *et al.*, 2015a), Kolo creek (Ogamba *et al.*, 2015b; Seiyaboh *et al.*, 2016a), Ikoli creek (Ogamba *et al.*, 2015c, 2016; Seiyaboh *et al.*, 2016b), Sagbama creek (Seiyaboh *et al.*, 2017a,b), Igbedi creek (Seiyaboh *et al.*, 2013a,b), Epie creek (Seiyaboh *et al.*, 2016c), Efi lake (Angaye and Meiyepa, 2015), Lake Adigbe among others. Within the surface water resources, several macrophytes exist. Some commonly found macrophytes include *Azolla pinnata var africana*, *Dryopteris filixmas*, *Eichhornia crassipes*, *Nephrolepis biserrata*, *Nymphacea lotus*, *Nymphacea maculate*, *Pistia stratiotes* and *Salvinia nymhellula* (Ohimain and Akinnibosun, 2010, 2008, 2007; Agedah *et al.*, 2015; Ogamba *et al.*, 2015a-c; Seiyaboh *et al.*, 2016b).

Basically, Water hyacinth (*Eichhornia crassipes*) is an invasive and noxious freshwater weed causing serious threats to water ecosystems (Nyananyo *et al.*, 2007; Ogamba *et al.*, 2015a-d; Ulaeto *et al.*, 2012; Baral *et al.*, 2011; Shanab and Shalaby, 2012). As such, *Eichhornia crassipes* has been referred to as the world's worst and most aquatic plant that deserves attention (Zhang *et al.*, 2012; Ogamba *et al.*, 2015d, e). Authors have reported that the plant has the tendency to accumulate toxic substances in water (Ogamba *et al.*, 2015c,d). As such it can be used for water purification.

Several studies have been carried out on the bioaccumulation of heavy metals from different water bodies in Bayelsa state. Some of the water bodies include River Nun (Ogamba *et al.*, 2015d), Ikoli creek (Ogamba *et al.*, 2015c). Therefore, this present study assessed the concentration of heavy metals in water, sediment and *Eichhornia crassipes* from Kolo creek, Niger Delta.

2.0 MATERIALS AND METHODS

2.1 Sample collection

Triplicate samples of the water, sediment and water hyacinths were collected from three locations viz: Kolo, Otusega and Imiringi along Kolo creek, Bayelsa state, Niger Delta region of Nigeria. Sampling was carried out July 2015. One liter sampling containers were used for collecting water samples and aluminum foil was used to collect the sediment. Jute bag was used to collect the *Eichhornia crassipes* (including the root, stem and leaves) (Ogamba *et al.*, 2015d). At the point of collection, the samples were carefully labeled and transported immediately to Laboratory for analysis.

2.2 Sample preparations and analysis

The sediment samples were air dried and sieved using mesh in the laboratory. Similarly, the *Eichhornia crassipes* samples were sundried and then blended using pestle and mortar. The samples (sediment and *Eichhornia crassipes*) were digested using nitric acid and then atomic adsorption spectrophotometer was used to carry out the heavy metal analysis.

2.3 Statistical analysis

Statistical analysis was carried out using SPSS software. The data were expressed as mean $\pm$ standard error. Thereafter, analysis of variance was carried out at $P = 0.05$. The source of observed difference was carried out using Duncan multiple range test statistics.

3.0 RESULTS AND DISCUSSION

Table 1 presents the heavy metal concentration in water samples from Kolo creek. The values ranged from 0.001 – 0.002 mg/l, 0.001 – 0.001 mg/l, 0.137 – 0.157 mg/l, 0.013 – 0.017 mg/l, 0.000 – 0.001 mg/l and 0.019 – 0.114 mg/l for lead, cadmium, iron, manganese, mercury and copper respectively. There was no significance variation ($P > 0.05$) among the levels of heavy metals in the water samples from the various sampling stations (Kolo, Imiringi and Otusega). Absence of variation suggests that difference in anthropogenic activities going on in the creek at various points (study location) do not alter the heavy metal concentration in the water. The concentration of heavy metals in the water is below the level specific for drinking water by Standard Organization of Nigeria (Nigeria drinking water guideline) SON (2007) and World Health Organization (2011). Again, this suggests that there is no heavy metal pollution in the creek.

Table 1: levels of some selected heavy metals in water samples from Kolo creek, Niger Delta

Location	Lead	Cadmium, mg/l	Iron, mg/l	Manganese, mg/l	Mercury, mg/kl	Copper, mg/l
Kolo	0.001±0.000a	0.001±0.000a	0.157±0.012a	0.017±0.003a	0.001±0.000a	0.114±0.083a
Imiringi	0.002±0.001a	0.001±0.000a	0.137±0.012a	0.013±0.003a	0.000±0.000a	0.025±0.001a
Otusega	0.002±0.001a	0.001±0.000a	0.143±0.003a	0.013±0.003a	0.000±0.000a	0.019±0.001a

Data is expressed as mean ± standard error (n=3). The same alphabets along the column shows no significant difference ($P>0.05$) according to Duncan statistics

The levels of some selected heavy metals in sediment samples from Kolo creek, Niger Delta are presented in Table 2. The concentration of lead, copper, cadmium, iron, manganese and mercury ranged from 1.676 – 1.757 mg/kg, 0.365 – 0.782 mg/kg, 0.137 – 0.147 mg/kg, 3.020 – 3.810 mg/kg, 0.407 – 0.490 mg/kg and 0.011 – 0.023 mg/kg for lead, copper, cadmium, iron, manganese and mercury respectively. Besides copper and iron, there was no significant difference ($P>0.05$) among the various locations for each parameter. Furthermore, apart from samples from Otusega for copper concentration and Imiringi for iron level, there was no significant difference ($P>0.05$) between the locations for copper and iron. Absence of significant variation in most of the heavy metals suggest activities leading to heavy metals in soil which deposits in the water sediment is typically the same at the various locations. The occurrence of heavy metals in the sediment far above the concentration in the water suggests the ability of materials including decomposing plants and animals and constituents of various wastes stream to accumulate at the sediment. The occurrence of heavy metals in the environment is typically from several anthropogenic activities resulting from urbanization, industrialization and geologic processes (Butu and Iguisi, 2013; Izah *et al.*, 2016).

Table 2: Level of some selected heavy metals in sediment samples from Kolo creek, Niger Delta

Location	Lead, mg/kg	Copper, mg/kg	Cadmium, mg/kg	Iron, mg/kg	Manganese, mg/kg	Mercury
Kolo	1.757±0.054a	0.419±0.011a	0.147±0.002a	3.810±0.021b	0.490±0.021a	0.023±0.002a
Imiringi	1.678±0.029a	0.365±0.029a	0.142±0.003a	3.020±0.099a	0.407±0.018a	0.013±0.006a
Otusega	1.676±0.051a	0.782±0.012b	0.137±0.009a	3.600±0.035b	0.460±0.031a	0.011±0.006a

Data is expressed as mean ± standard error (n=3). The same alphabets along the column shows no significant difference ($P>0.05$) according to Duncan statistics

The levels of some heavy metals in tissue of *Eichhornia crassipes* from Kolo creek are presented in Table 3. The heavy metal concentration ranged from 0.002 – 0.003 mg/kg, 0.003 – 0.004 mg/kg, 0.000 – 0.004 mg/kg and 0.040 – 0.048 mg/kg for lead, cadmium, mercury and copper respectively. Lack of significant variations among the various locations suggested that the level of heavy metal in the tissues of *Eichhornia crassipes* from Kolo creek is an indication of similarity in the activities leading to heavy metals in the surface water around the study area. The concentration of heavy metals in the tissues of *Eichhornia crassipes* was very low. This suggests no significant bioaccumulation of heavy metals in the *Eichhornia crassipes* in the study area. The low concentration could be due to low concentration of heavy metals in the water samples.

The concentration of heavy metal in water hyacinth tissues in this study is lower than the concentration reported for water hyacinth tissues from other surface waters in Bayelsa state. For instance, Ogamba *et al.* (2015c) reported concentration of lead and mercury in tissues of *Eichhornia crassipes* from Ikoli creek in the range of 0.970 – 2.387 mg/kg and 0.010 – 0.017 mg/kg respectively. Ogamba *et al.* (2015d) reported cadmium and lead in *Eichhornia crassipes* from River Nun in the range of 0.022 – 0.045 mg/kg and 1.095 – 2.450 mg/kg respectively.

Table 3: Level of some selected heavy metals in Water hyacinths samples from Kolo creek, Niger Delta

Location	Lead, mg/kg	Cadmium, mg/kg	Mercury, mg/kg	Copper, mg/kg
Kolo	0.003±0.000a	0.003±0.000a	0.001±0.000a	0.048±0.002b
Imiringi	0.002±0.000a	0.003±0.000a	0.004±0.003a	0.040±0.000a
Otusega	0.002±0.000a	0.004±0.000b	0.000±0.000a	0.041±0.001a

Data is expressed as mean ± standard error (n=3). The same alphabets along the column shows no significant difference ($P>0.05$) according to Duncan statistics

4. CONCLUSION

Eichhornia crassipes is often regarded as one of the worst invasive aquatic plants. The plant causes several obstructions in water ways. This study investigated the heavy metals concentration in water, sediment and *Eichhornia crassipes* from Kolo creek, Niger Delta, Nigeria. The study found that the heavy metals in the water were below the specified limits for drinking water as recommended by World Health Organization and Standard Organization of Nigeria. The concentration was also low in *Eichhornia crassipes*. Typically the heavy metal concentration were in the order; sediment > water > *Eichhornia crassipes*. The concentration suggests that Kolo creek is not contaminated by heavy metals found in the environment.

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