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Annals of Biological Research, 2015, 6 (11):72-77
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0976-1233
CODEN (USA): ABRNBW

Heavy metals contamination of the sessile bivalve, *Crassostrea gasar* (mangrove oyster) in A[i] post oil spilled brackish water creek of the NIGER Delta, Nigeria

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ABSTRACT

Monthly sampleof three months periodto determine levels of petroleum bearing heavy metals contamination of Fe, Pb, Ni, Cd, Hg, and Cu in tissues of Crassostreagasar (oyster) were obtained from B/DereCreek system of the Niger Delta. The brackish water creek was polluted with spilled crude oil,from an oil facility in the area,impacting resident aquatic resourcebiota including, the sessilemollusk, Crassostreagasar. Analyzed tissuesamples showedpresence of the heavy metals.M, Bioaccumulationlevel of metals per gram of the animaltissue were of the range;Lead(0.11mg/g-0.14mg/g), Nickel (0.001mg/l-0.13mg/g), Cadmium (0.001mg/g-0.05mg/g), Mercury (>0.001mg/g), iron (182.44mg/g-320.09mg/g)and Copper (0.001mg/g-0.05mg/g). Mercury, Lead and Cadmium (Hg, Pb, Cd) were within permissible limitof WHO,while others were abovethe permissible limit.It wastherefore recommended that consumptionof the animalsfrom this water body bechecked to minimize food poisoningor complications resulting from their contamination.

Key words: *Crassostreagasar*, Niger Delta, heavy metals, bioaccumulation, biomagnifications,

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INTRODUCTION

Oyster is a common name for a number of distinct groups of sessile bivalve mollusks inhabitingboth marine and brackish habitats. They are relatively more abundant in calm or slow running waters of tropical coast, where they often form large reefs on rocks, cluster on submerged mangroves trunks and roots. They are identified by their hard calcified shells which are oval, shaped like teardrops that protect the soft edible tissues. Oysters are shellfish that provides important source of protein food. They spend all their lives attached to hard surfaces, except the first few weeks when they are planktonic.The animals are delicacy to most coastal dwellers and are of high commercial value. In the Niger Delta region where thestudywascarried out, it is a major source of income to rural dwellers. It is either eaten cooked, roasted or raw. Aside protein, it is a rich source ofcalcium,iron,iodine, omega 3,cholesterolreducing fatty acids,vitamin D, vitamin B but low in saturated fat. Oysters also contain zinc, and vitamin that enhance vision and boosts the immune system [1]. They contain the amino acid tyrosine, whichis useful to brain function and improved mental performance. According to legend, eating raw oysters boosts onessex life. While there is still scientific debate over how true, recent studies suggest that unique types of amino acids such as aspartic acid (D-ASP) and N-methyl–D-aspartic (NMDA)-found in the shell fish boost sexual performance [1]. The high zinc content in oystersis helpful in raising the libido of men. Therapists recommend eating oyster to help in sexual disorder due tothe high iron content. Oysters are excellent source of zinc, iron, calcium, selenium as well as vitamin A and vitamin B_{12} [2].

Aside its great value as food, it maintains healthy ecosystem through filter feeding.Oysters take in nitrogenous compounds such as nitrates and ammonia, thereby cleansing the water body of nitrogenous compounds. In the process, theytake in food with contaminantspresentin the water body.Oysters have been recognized,long before now as good accumulators of organic and inorganic substances [3]. Accumulatedsubstances are transferred to other animals including humans in food chains [4]since it is a delicacy.Heavy metalsdischarge as waste intowater has significant effect on fish and other aquatic organismsand may endangerthe human populace who through consumption of contaminated animalsacquire the metals [5]. Contaminations of the sessile organism depend on the level contaminant in the environment. Thus, exposure to elevated contaminantlevelas in oil spillage is risky.Studies have shown that most aquatic plants and animals like sea weeds,mollusk, crabs and fish, find it difficult to regulate metal intake and actually suffer from metal storage (accumulation) problems [6].Heavy metal toxicity in aquatic organism is associatedwith residence time the contaminant resided within the food chains. The potentials for human exposure make it imperative to monitor heavy metal concentrations in aquatic organism [3].Oysters continually buildshell. Study on growth rings in the mollusk shells in a post oil spill environment have shown that contaminants present in the environment are incorporate into the shells, Peter [4]. The study furtherrevivedthat several heavy metals common in crude oil areincorporated into the shells. Higher concentrations of three heavy metals(vanadium, cobalt and chromium) common to crude oil were observed. It was evident that these contaminants from crude oil entered the food chain [5]. It was demonstrated that oysters collected in post-spill contain significantly higher concentrations of heavy metals in their shells, gills and muscle tissues than those collected before spill.

Microscopic evidence showed “metaplasia” or transformation of tissues in response to the disturbance in 89% of post-spill specimen. Cells that were originally columnar (standing up straight) became stratified (flattened), a sign of physical or chemical stress in oysters. Stratified cells have less surface area available for filter feeding and gaseous exchange, which are the primary functions of oyster gills [7]. Oysters suffering from this type of metaphase will likely have trouble reproducing, leading to lower population size and less unavailability of food for oyster predators. Exposure and ingestion can cause health problems, such as cancer,neurological and reproductive disorder, in people and animals.

Metallothionein (MT), a low molecular weight substancerich in cysteine protein, regulates copper and zinc homeostasis to detoxify cells of cadmium and mercury. Over exposure to heavy metal contamination leads to overproduction of MT that cause damage tosystems of the organism [8], [9],[10], [11], [1]. The level of metallothioneinin tissue is a function of heavy metals in that organism.Relatively, mussels showhigher rates of accumulation of metals than other species because of their filter feeding habit and sessile life history. This is especially true forCadmium [3].

Most coastal belts like the Niger Delta of Nigeria are highly populated due toindustrial, agricultural, mining activities, and distribution of petroleum products [12]. Oil production in the region has interfered with recreational activities ofbathing; boating and fishing, causingdevastating effect on human communities [13].Threats to aquatic biota are persistent with physical smothering of surface water [14], [13]. Increased industrialization in the past four decade has resulted in increased effluents being discharged into the aquatic systems of the Niger Delta. These wastes are potential source of trace elements in surrounding environment [15]. The industrial effluent generally contains high quantity of dissolved, suspended particles including toxic metals, low dissolved oxygen and high biochemical oxygen demand (BOD) which cause deleterious effects on water, sediment and vegetation[16], [17].

MATERIALS AND METHODS

The study was carried out in B/Dere Creek,a brackish creekof the Niger Delta, Nigeria in five stationsbetween longitude 04^o 40´56"N to 04^o41´18"N and Latitude 007^o13´8"E to007^o14´26"E with elevation range of 5ft to 28ft East of Bonny estuary.TheVegetation was dominantof *Rhizophoraracemosa* and *Avicennia*.Faunal organisms of the creek include shellfish such as periwinkle,Calinectis, crustacean, *Crassostreagasar* (identification according to [18],and fin fish such as Tilapia.Sampling was during low tidal level (LTL). Specimen animals were obtained along the river banks. Extraction procedure withPAA method was used to tissuesanalysis for metals. The animal tissues weredried to constant weight after extraction from shells. The dried tissues were grinded topowder and 5g added to 5g of sodium sulfate in a small amber bottle.The mixturethoroughly stirred with 25ml of dichloromethane or methyl chloride solution to extract the Hydrocarbon content of sample. Sample was allowed to stand for about an hour.After which the mixture was filtered through a funnel packed with cotton wool, sodium sulfate andsiucal gel to remove debris. The supernatantwas evaporated with nitrogen gas and diluted with 1ml of solvent and mixed thoroughly. One micro litter of this was injected into gas chromatography to elude the compounds contentof sample. Atomic absorption spectrum (AAS) procedure with direct air acetylene flame method was used for analysis of heavy metal samples after digestion.

RESULT AND DISCUSSION

The results of the study are here presented inFig. 1-6. Heavy metal concentrationsin *Crassostreagasar*tissues showed, Cd values ranged from 0.001mg/g to 0.05mg/g. The mean values ranged from 0.01mg/g ± 0.01 to 0.02mg/g ± 0.03. Fe ranging from 182.44mg/g to 287.00mg/g dry weight of the animal had mean valuerange of 253.34mg/g±80.81 to 320.09mg/g±35.80.Both cadmium and iron values were observed to be highestin the month of April, while lead and nickel were highest in the animal tissues in August. Copper (Cu) was within the range of 0.001mg/g to 0.13mg/g while the mean values among stations was 0.01mg/g±0.01 to 0.05mg/g±0.07. Lead value range was 0.004mg/g to 0.02mg/g with stationsmean range of 0.009mg/g±0.009 to 0.02mg/g±0.02.Nickel, with a value range of 0.001mg/g to 0.01mg/ghad meansranging from 0.06mg/g±0.07 to 0.13mg/g±0.20.However, the concentration of mercury in *Crassostreagasar*of the creek was low in the tissue of the organism relative to the other metals measured. Values recorded were less than 0.001mg/g(>0.001), as seen in Fig 6. In the month of August, concentrations per stations were below detectable limit (BDL). This implies that the animals have low accumulation affinity for mercury.The order of bioaccumulation of the metals was Fe > Ni > Cu > Cd >Pb>Hg, as in the result presented.

The results of the study agreed with certified values of World Health Organization (WHO). The bivalves as filter feeders, accumulated the metals and others pollutants from the water column by ingesting contaminants thatadsorbed to phytoplankton, detritus and sediment particles. The result reflects other contaminated sites in the Niger Delta [19], [20]. Marine bivalves such as oyster have been extensively used as model organisms in environmental studies of water quality. Metals are taken up and accumulated by oysters and other marine invertebrates. Tissue concentrations are usually higher than those in surrounding water. The total metal concentration in the tissues were also similar to studies in Gulf of PariahH, with highest metal levels in tissues occurring close to areas highly contaminated by the spill [21], [22] . Oysters accumulate metals such as copper and zinc and can tolerable very high metal concentration, without apparent detrimental effect on the organism [23], [24]. In particular, the high concentrations of lead, zinc and mercury detected in oyster tissues gave cause for concern since they will eventually affect the rest of the Gulf of Paira, due to the circulatory patterns in the Gulf [25].

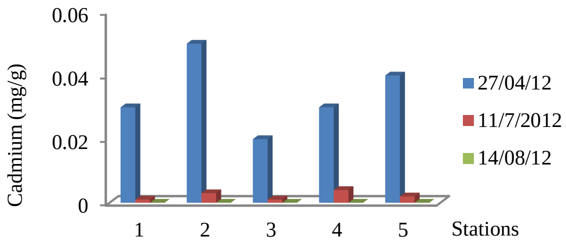

Fig. 1 Cadmium concentration in *Crassotra gasar* of Bidere Creek during the period of study.

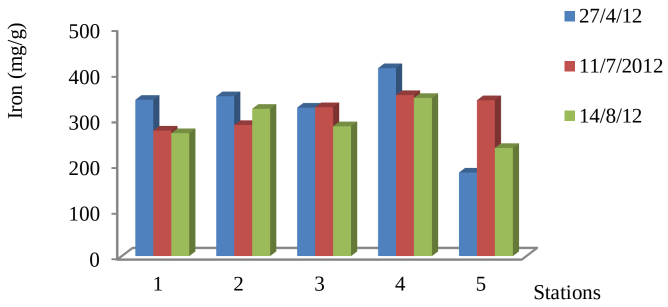

Fig. 1 Iron concentration in *Crassostrea gasar* of Bidere Creek during the period of study.

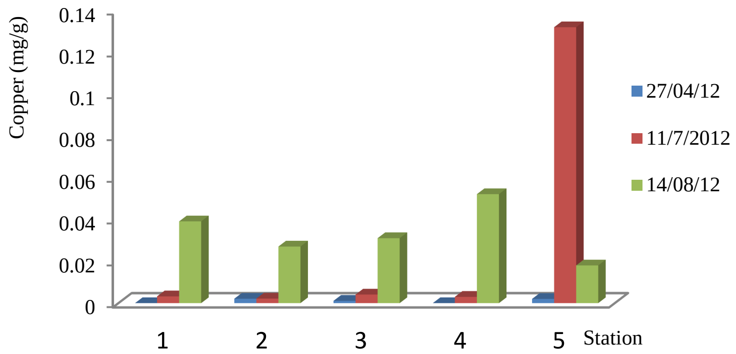

Fig.1 Concentration of Copper in *Crassostrea gasar* of Bidere Creek during the period of study .

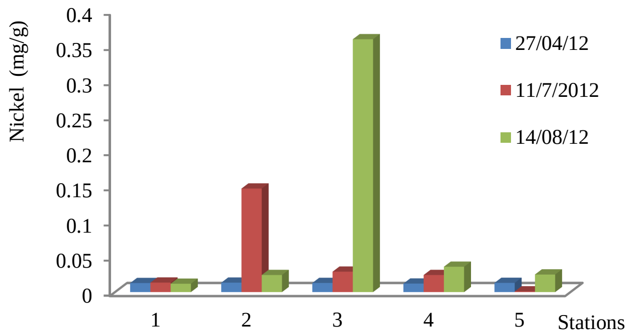

Fig.5 Nickel concentration (mg/l) in *Crassostrea gigas* of Bidere Creek during the period of stuudy.

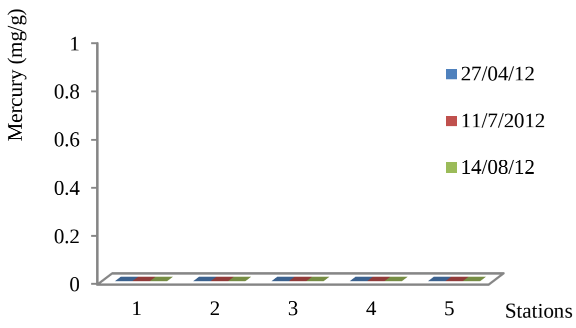

Fig.1 Concentration of Mercury in *Crassostrea gasar* of Bidere Creek durint thr study period.

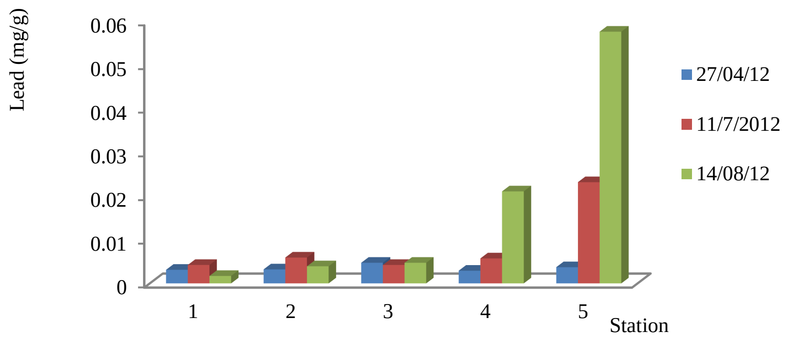

Fig. 3 Lead concentration (mg/l) in *Crassostrea* gasar of Bedere Creek during the peripod of study

CONCLUSION

The levels of Heavy metals of Cadmium (CD), Lead (Pb), Mercury (Hg), Nickel (Ni), Iron (Fe) and Copper (Cu) found in oyster of B/Dere Creek were generally low within the months of April, July and August, limit for contaminants in food set by regulatory bodies in several countries (US), EU). Except Iron (Fe) and Copper (Cu) that has values which is more than the tolerable limit of WHO (3.539.to 350.119). The heavy metals levels were mainly corresponding to the natural back ground levels except for Fe and Cu. Increasing human activities in B/Dere creek system increase heavy metal level.

Education of Micro elements accumulation including toxic heavy metals in aquatic ecosystem is of great important for the assessment of the pollution level. Based on the results, the disruption of Heavy metals in water, sediment, and plankton and Bioaccumulation factor (BF) in oyster indicate that the concentrations of these metals are derived from water with irregular increase of pollution levels from residential areas.

Therefore the knowledge of heavy metal concentrations in oyster is very important with respect to nature management, human consumption of these species and to determine the most bio-monitor species and the most polluted area.

Recommendations

Pollution as global problem is undisputable, Government and organizations work together to proffer solution. To solver the oil pollution problem in the B/Dere Creek, private industries environmental organizations, and individuals should work together with the aim of reducing the level of pollutants discharged into rivers system Beach cleanup, recycling programs, in the immediate is recognized. More strict regulations and enforcement by individual and co-operation should be put in place to help in reducing oil pollution in river system and beyond.

Finally, special attention should be given to the organisms of the River system, since shape is determined by the substrate to which they are attached. Their weight as well as size can be considered a limiting factor with respect to heavy metal accumulation.

It is here by recommended that the levels of heavy metals in oyster from B/Dere creek system were not within the acceptable limits of world's health organization (WHO). Nickel (Ni) was within 1.97, Copper (Cu) 2.32. Iron (Fe) 269.51. Except mercury (Hg) lead (Pb) and cadmium (CD) which were within the permissible limit (<0.001). Therefore the use of oyster from B/DereCreek system of Gokana River State should be minimized to avoided acquisition of these toxic metal pollutants which could cause serious health problem to the human consumers.

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