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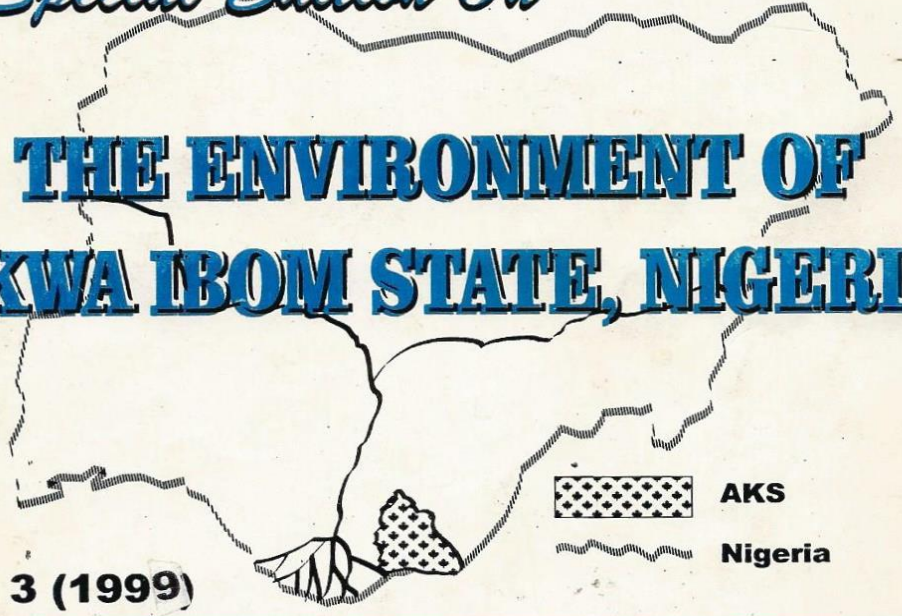

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Use Of *Tympanotonus fuscatus*, *Grassostrea gasar* And Water Quality To Assess The Pollution Status Of Douglas Creek, Nigeria.

By

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ABSTRACT

The Microbiological and heavy metals content of Periwinkle (Tympanotonus fuscatus), Oyster (Grassostrea gasar) and water samples were used to determine the pollution status of the Douglas creek where the resources were harvested. The microbial count of T. fuscatus and G. gasar samples ranged from 1.3×10^4 *cfu/g to* 3.7×10^6 *cfu/g, and* 1.2×10^5 *cfu/g to* 2.6×10^7 *cfu/g, respectively, while the counts of the water samples ranged from* 2.0×10^3 *cfu/ml to* 2.2×10^5 *cfu/ml. The total coliform count of T. fuscatus and G. gasar were* 6.4×10^4 *cfu/g and* 3.0×10^5 *cfu/g, respectively while that of water was* 1.1×10^4 *cfu/ml. The microbial isolates from the samples were identified as Vibrio alginolyticus, Enterococcus feacalis, Shigella dysenteriae, Proteus vulgaris, Staphylococcus aureaus, Micrococcus varians, Escherichia coli, Bacillus cereus, Salmonella typhi, Aspergillus fumigatus, Penincillium sp, Mucor sp, and Fusarium sp. The public health implication of these microbial isolates in samples and the pollution status of Douglas creek have been discussed. The heavy metals detected from the samples were zinc, lead, iron, cadmium, chromium, nickel, manganese and copper and were found to be below the World Health Organization (WHO) standards. The possibility of bioaccumulation of these heavy metals to toxic levels as was the case of methyl mercury in Minimata Bay, Japan should not be ignored. The proximate nutrient composition of periwinkle and oyster samples showed high protein contents (58.13% and 59.53%, respectively) compared to a whole hen's egg (44.60%) and could be used as a cheap and available source of protein.*

KEY WORDS: *Tympanotonus fuscatus*, *Grassostrea gasar*, pollution status, Douglas creek, Biomarker, Microorganisms, Heavy metals.

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INTRODUCTION

The unprecedented population increase and industrial development during the 20th century has not only increased conventional solid and liquid wastes pollutants to critical level, but has also provided a range of previously unknown pollution problems for which the environment was unprepared (Atlas and Bartha, 1981). Douglas creek (DC) one of the numerous creeks along the lower Qua Iboe river estuary (LQIRE) in Nigeria is not exempted from these pollution problems. It is the point source where petroleum production wastes from the Qua Iboe Terminal (QIT) of the Mobil Producing Nigeria Unlimited (MPNU) are dumped into the LQIR and the adjourning creeks. MPNU exploration and production (E&P) activities started in Akwa Ibom State in 1969 and is now known to be the second largest producer of crude oil in Nigeria and the largest producer of condensate in Africa (Udotong, 1995).

Douglas creek is recognized as the major contributor of pollution to LQIRE (Grevy, 1995). The dumpsite of the oily sludge from QIT and the gas flare stack where gas is continuously flared are located a few metres from this creek. The consequences of the gas flare and pollution are also documented (Obioh et al; 1996). The creek also serves as a boundary of MPNU onshore facility when the Mobil QIT 750 TBD (crude) expansion project is commissioned (Unilag Consult, 1997).

Apart from the continuous discharge of the wastewater from QIT into Douglas creek, there are reports of oil spillages that have impacted this creek (Mobil News, 1995). One major oil spill that impacted the creek is the recent 40,000 barrels MPNU oil spill of 12th January 1998 on the Nigerian coastline. This was reported by MPNU to be the largest oil spill ever recorded by MPNU in all her 30 years of operations in Nigeria. The spill spread through the entire 800km Nigerian coastline (Udotong, 1999). Following the said MPNU oil spill, there has been serious concern expressed about the rapidly deteriorating state of water bodies and aquatic resources with respect to heavy metal pollution (Jaleel et al; 1996) and microbial contamination.

Seafoods and shellfishes in general have been shown to be rich in protein (Ifon and Umoh, 1986). They are therefore consumed by coastal dwellers as cheap source of protein to supplement the costly conventional protein source to combat the prevalent protein energy malnutrition in rural slums in Nigeria. Between 1985 – 1986, the centre for food safety and Applied Nutrition, United States Food and Drug Administration estimated concentration of cadmium, lead and other elements in fresh periwinkle and oysters collected from United States Coastal areas to be used for shellfish production (Capar and Yess, 1996). This is because these periwinkles and oysters are prone to accumulate heavy metals in polluted aquatic habitats (James, 1985; Ashraf and Jaffer, 1989). Also the consumption of these contaminated aquatic resources could lead to outbreak of food borne diseases (Ekanem and Adegoke, 1995). Because of the importance of these aquatic resources, there is need for monitoring its quality since it depends on the quality of the environment.

Environmental biomonitoring considered the need for monitoring the environment and heavy metal pollution using animals and plants, human hair and lichen as biomarkers or biomonitors (UNEP, ILO; WHO; IPCS; 1993; Subramian et al; 1997). No biomarker or biomonitor has been identified as a measure of the pollution of Douglas creek, Nigeria. Thus, periwinkle and oyster (Phylum: Molusca), a common edible aquatic resource in southeastern zone of Nigeria, are capable of accumulating toxic metals from the polluted aquatic environments. According to Udotong (1999) diet is the main source of human exposure to toxic elements, and so the levels of these elements in basic foodstuffs are of great interest from toxicological and nutritional point of view. Although some studies have been conducted on metals of some univalves (Udotong, 1999), there appears to be no information on levels of some metals and microbiological quality of both univalves and bivalves in Douglas creek. Moreover, no biomarker has been identified as an indicator of pollution of Douglas creek. This study therefore became necessary, not only to find out how safe, for consumption periwinkles and oysters from Douglas creek are with reference to toxic metals content and microbial load and types, but also to determine the pollution status of Douglas creek.

MATERIAL AND METHOD

Study Area

Douglas creek (Fig. 1.0) is located along the lower Qua Iboe river estuary, which lies within latitude 4°4S′N and longitude 7°30′ to 8°00′E on the southeastern Nigeria coastline. It is a mesotidal creek having tidal amplitude of 1m and 3m at neap and spring phases respectively (Ekwere et al; 1992). Douglas creek is the point source where petroleum E&P wastes from QIT tank farm are dumped into the LQIRE and the adjourning creeks. The sampling location were:
A - Mouth of Douglas creek
B - Douglas flare stack
C - Douglas by QIR.

Samples Collection

Oysters, periwinkle and water samples were collected from Douglas creek at three designated locations into sterile sampling containers. Oyster samples were collected by cutting the branches of mangrove plants in which they are attached and transferred to the laboratory for analysis.

Sample Analysis

Microbiological Analysis
(a) **Serial Dilution:** Serial dilution of water and homogenized oyster and periwinkle samples were differently carried out by pipetting 9ml of sterile normal saline into seven test tubes. One milliliter of the water and homogenized oyster and periwinkle samples were introduced into the first test tubes respectively to give a dilution of 10^{-1} and subsequent dilutions were made to 10^{-7} (Harrigan and McCance, 1976).

(b) **Inoculation and Incubation:** Appropriate nutrient media plates were inoculated using appropriate diluting according to Harrigan and McCance (1976). Inoculated plates were incubated at appropriate conditions for 24 –48h. The plates were read and the values expressed in cfu/ml or cfu/g.

(c) **Identification of Isolates:** The characterization and identification of microbial isolates was carried out using methods of Cowan and Steel (1976) and Bannette and Pankhurst (1974).

Physiocochemical Parameters
The heavy metals content of the samples was carried out using standard procedures of Atomic absorption Spectrophotometric and APHA (1976), and AOAC (1976).

Proximate Nutrient Composition
This was carried out using the methods of AOAC (1975).

RESULTS

Microbial Counts
The microbial count of microorganisms isolated from water, oyster and periwinkle samples from Douglas creek is shown in Table 1.0

Heavy Metals Count Of Samples
The heavy metals content of oyster, periwinkle and water samples from Douglas creek is shown in Table 2.0. The heavy metals detected in the sample were above International Standards.

Proximate Nutrient Composition Of Oyster And Periwinkles
The proximate nutrient compositions of oyster and periwinkle samples are shown in Table 3.0. *T. fuscatus* has a higher protein content than *G. gasar* and both are better sources of protein than a whole hen's egg with a protein content of about 44.6%.

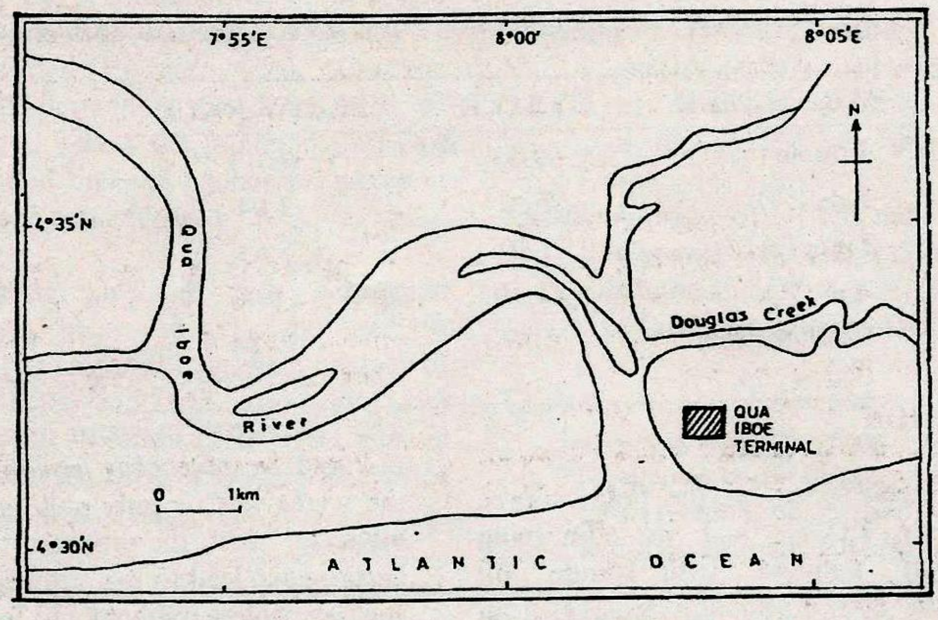

Fig. 1.0: Qua Iboe River Estuary showing Douglas Creek

Table 1.0: Microbial Counts of water, oyster and periwinkle samples from Douglas creek

Samples	**Microbial Count**									
	Total Heterotrophic				**Total Coliform**		**Total Fungal**			
	A*	**B***	**C***	**D***	**A**	**B**	**A**	**B**	**C**	**A**
Water	3.4×10^4	2.2×10^3	6.9×10^5	5.9×10^3	11×10^4	2.1×10^3	2.2×10^5	2.0×10^3	5.9×10^3	5.6×10^4
Oyster	3.2×10^5	2.6×10^7	2.5×10^5	5.5×10^4	3.0×10^5	3.7×10^4	2.6×10^4	1.2×10^5	5.5×10^4	5.3×10^5
Periwinkle	6.0×10^4	3.7×10^6	3.8×10^5	5.6×10^4	6.4×10^4	4.5×10^3	3.4×10^5	1.3×10^4	5.6×10^3	4.6×10^3

A,B,C – represents sampling locations along Douglas creek.

Table 2.0: Heavy metals content of oyster, periwinkle and water samples from Douglas creek

Heavy Metals	**Samples**		
	Oyster	**Periwinkle**	**Water**
Lead	1.61 $\mu g\ g^{-1}$	1.03 $\mu g\ g^{-1}$	0.23 $\mu g\ l^{-1}$
Iron	3.18 $\mu g\ g^{-1}$	3.34 $\mu g\ g^{-1}$	0.12 $\mu g\ l^{-1}$
Cadmium	0.90 $\mu g\ g^{-1}$	0.84 $\mu g\ g^{-1}$	0.31 $\mu g\ l^{-1}$
Nickel	0.32 $\mu g\ g^{-1}$	0.35 $\mu g\ g^{-1}$	0.10 $\mu g\ l^{-1}$
Vanadium	0.50 $\mu g\ g^{-1}$	0.43 $\mu g\ g^{-1}$	0.08 $\mu g\ l^{-1}$
Zinc	1.03 $\mu g\ g^{-1}$	1.00 $\mu g\ g^{-1}$	0.63 $\mu g\ l^{-1}$
Cupper	1.20 $\mu g\ g^{-1}$	1.00 $\mu g\ g^{-1}$	0.71 $\mu g\ l^{-1}$

Table 3.0: Proximate composition of Oyster and Periwinkle from Douglas Creek

PARAMETER	OYSTER	PERIWINKLE
Protein (%)	59.53	68.13
Fats (%)	7.20	3.04
Fibre (%)	5.40	5.63
Ash (%)	21.60	12.96
Carbohydrate (%)	6.27	10.24

DISCUSSION

Douglas creek serves as the point source from where LQIRE and its adjourning creeks get polluted with crude oil Exploration and production wastes from Qua Iboe Terminal (Grevy, 1995). Protein supplements to not only the dwellers of coastal countries but by Nigeria on the whole. This is why it is necessary to evaluate the pollution status of the creek considering that aquatic resources from here serve as important food resource. Although the aquatic resources (oyster and periwinkle) serves as available and cheap source of protein, they harbour pathogenic microorganisms and heavy metals that constitute health hazards to man. The microbial counts of the aquatic resources analyzed in this work were generally higher than in water samples.

The high bacterial count of 3.7×10^6 cfu/g and coliform of 6.4×10^4 cfu/g of periwinkle and oyster when compared with International Commission of Microbiological Specification for Food, ICMSF (1982) of 1.0×10^3 and the United State Food Drugs and Administration limit of not greater than 10^5 and coliform of not greater than 10^2 of shell fishes for consumers safety (Caper and Yees, 1996) indicates that these shellfishes are unwholesome and therefore not fit for consumption.

The presence of indicator organisms like *E-coli* and *Streptococcus feacalis* reveals that the water was recently polluted with feacal matters. Also the presence of pathogenic bacteria can lead to the outbreak of diseases such as cholera, typhoid and food poisoning if the periwinkle and oyster eaters from this river are not well cooked. This makes Douglas creek a unique study area to obtain the baseline data with which the pollution of the environment could be measured.

Heavy metals represent a significant source of pollution in aquatic environment. The heavy metals exert toxic effects at high concentration and in response to this toxic effect, many aquatic microorganisms can develop tolerance (Dean-Rose and Mills, 1989). It is because of their properties under such circumstances they are used as biomarkers of pollution arising from industrial processes (Jaleel et al; 1996).

Industrial activities in the QIT, E&P activities in MPNU on the whole and MPNU effluent discharge in particular and storm water run-off into the Douglas creek. The heavy metals detected include iron, zinc, and cadmium in water samples, which were below FEPA standards of zn (0.1µg/l) and cd (2.0mg/l) (FEPA, 1981). Iron, zinc, nickel, copper and manganese detected in oyster and periwinkle samples were found to be above International Standard. In Japan, there was methyl mercury pollution at Minimata Bay and lubutylin contamination for French oyster beds whose effect was bioaccumulation of mercury by fishes/shellfishes, which resulted in the outbreak whereby about fifty consumers died (Hodges, 1970). Thus the oyster and periwinkle could be used as biomarker to assess the pollution status of the creek and that the aquatic resources in the water are contaminated.

The crude protein value of the periwinkle and oysters being 58.13% and 59.53% respectively compared to protein content of a whole hen's egg (44.69%) (Ifon and Umoh, 1980) confirms that these aquatic resources can be used as a cheap source of protein if properly conserved.

Integrated Coastal Zone Management (ICZM) approaches can be used to conserve these important cheap protein supplement and biomarkers.

CONCLUSION

The study reveals that water, oyster and periwinkle samples obtained from Douglas creek are polluted with pathogenic microorganisms and heavy metals Feacal matter, effluent and oily wastes discharges other industrial and domestic activities and storm water runoff from agricultural farms are the most likely source of pollution in this creek.

Effective and sustainable ICZM framework should be put in place for the lower QIRE as this will help in the reduction of hazardous effects on human as well as aquatic resources in the environment.

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