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EFFECTS OF ABATTOIR WASTES ON BENTHIC MACROINVERTEBRATES OF THE ELECHI CREEK, PORT HARCOURT, RIVERS STATE, NIGERIA

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ABSTRACT

The effect of abattoir waste on the benthic macro-invertebrates of the Elechi creek Port Harcourt was undertaken between June 2012 and August 2012, to assess the impact of biological oxygen demand, dissolved oxygen, chemical oxygen demand, total suspended solid, total dissolved solid, temperature, faecal coliform counts and total coliform counts on the composition and distribution of benthic organisms. Ten taxa representing nine families were recorded. The most abundant groups was crustacean which accounted for 30.0% and 3 species of the ten taxa recorded. Oligochaeta, polychaeta and Hirudinea has 20.0% respectively and this accounted for 2 taxa each while insect had only one taxa with 10.0% composition. There was variation in the density of macro-invertebrates from station 1 to 3, the highest density was in station 1 (103) and followed in decreasing order in subsequent stations. Station 2 (30) and station 3 (25). *Tubficid* sp was highest in station 1 (40) which decreased progressively in subsequent stations, station 2 (10) and station 3 (8). This amounted to a mean density of 19.3 per m^2 while *Desmocaris trispinosa* was 4 species with a mean density of 1.3 per m^2. The deterioration of water quality is evident by high BOD, (60mg/L), COD (54.0mg/L), DO (12.08mg/L), TDS (40.00mg/L), TSS (1360.00mg/L), and low temperature of (26^0C). Values of microbial analysis ranged from 1600 to 2400 MPN/100ml for total coliform count while faecial coliform count ranged from 4 to 2400MPN/100ml. The results indicated that abattoir wastes have adverse effect on the benthic macro-invertebrates. This observation showed that with a continuous discharge of waste into the aquatic ecosystem could lead to the death of aquatic organisms in the water bodies.

KEYWORDS: Pollution, wastes, benethic macroinvertebrates, abattoir and slaughter.

INTRODUCTION

Nitrogen plays a critical role in the productivity of every ecosystem, hence nature ensures accurate balance through its recycling between organic and inorganic forms by using micro organisms in mineralization, nitrification and denitrification processes. In aquatic ecosystem, improper management of nitrogen can contribute to the water quality degradation therefore identification of nitrogen sources is crucial for management response and regulation of water quality issues (Rosenberg *et al*, 2006).

Benthic macro invertebrates are widely spread in their distribution and can live on all bottom types. Many benthic species are able to move around and expand their distribution by drifting with current to their terrestrial phase (Hart, 1994).

The advantage of using benthos to monitor water quality unlike fish is that benthos are stationary so they are less able to escape the effect of sediments and other pollutants that diminish water quality (Plummer, 1978). Therefore they can give reliable information on water quality.

Microbial communities quickly respond to change in many environmental parameters hence the dynamics of their population and metabolism are relevant indicators of the ecological status of many ecosystem. This study evaluates the effects of abattoir wastes on benthic macro-invertebrates in a tropical fresh water ecosystem.

Kiely (1998) explained that animals waste have considerable amount of organic matters and reactive in organic species and this evident by the high concentration of both Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). High densities of animals as in the case of abattoir operations results in large quantity of animal wastes which leads to eutrophication. Eutrophication is the phenomenon of over enrichment of waters by nutrients, principally nitrate and phosphate beyond natural levels in water bodies, algae and other microscopic plant life in the lake becomes super abundant thereby choking the lake and causing it to eventually dry up completely (James and Moore, 1999).

STUDY AREA

The abattoir is located at the bank of the new Calabar river. The structure has an elevated concrete floor slab, which serves as a slaughtering surface. A certain amount of animals such as cows, goats and pigs are slaughtered daily. In the Choba abattoir, an estimate

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of 60-70 cows is slaughtered on weekly. The cows are slaughtered manually by falling the cows with strong thick ropes. The cows are slaughtered with sharp deep knife cut through the neck releasing blood leading to a complete death of the animal.

There are small drainage channels around the slab that is connected to a large channel through which the animal waste is being discharged into the water body. Water taps are mounted around the slab area used to supply water in preparing the slaughter animals and in washing the slab after the slaughtering of the animals.

The New Calabar River is the main source of water for drinking purpose, traditional recreation and industrial use. Its source is at Elele Alimini and it empties into the Atlantic ocean. The study area which is fresh water and beyond Choba, the river gradually turns brackish. An illustration of the abattoir is presented in (Figure 1). For the purpose of this study the entire river is divided into three (3) stations.

Station 1: (Choba market), slaughter house waste water at the point of discharge. Station 2: (back of indomie company), the site is located 10m upstream from the source. Station 3: (Choba beach), the site is located 10m down stream from the source.

MATERIALS AND METHODS

Collection of sediments samples

The sediments samples were collected with the help of Eckman grab measuring $225cm^3$ in each location, three replicate samples of benthic organisms (making up composite sample) were collected at 14 days intervals for 3 months between June 2012 – August 2012, from Elechi Creek, Port Harcourt.

The samples were taken to the laboratory and sieved through a mesh size 62 morons and preserved in 10% formalin solution. Rose Bengal was added to stain all living tissues. Benthic invertebrate were sorted out by transferring successive quantities of preserved residue into a white plastic tray. Moderate volume of water (50-100ml) was added to improve visibility. Large benthic organisms were picked with forceps while smaller one were pipette out. All the sorted macroinvertebrates were then preserved in 10% formalin for further identification and counting. Benthic macroinvertebrates were identified to their lowest possible taxonomic level under light and stero-dissecting microscopes using the keys of Day (1997) and Hart (1994). The number of each identified species or taxon was counted and recorded.

In addition, six variables, biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), dissolved oxygen (DO), temperature (OC), total suspended solids (TSS) and total dissolved solids (TDS), were measured for each sample site per sampling period to assess the impact of these factors on benthic macroinvertebrates distribution along the river. These variables were chosen to determine the water quality and pollution effects especially from abattoir waste. Water samples for the determination of BOD_5, COD, TSS, TDS and temperature were collected from each sample site during high tides. The Argentometric method was used to measure chloride (APHA, 1985). The Azide modification method was used to determine the initial and final dissolved oxygen (DO) (APHA, 1985). BOD_5 was computed from the difference between initial and final DO. While COD determination is a measure of the oxygen equivalent of that portion of the organic matter in a sample that is susceptible to oxidation by a strong chemical oxidant. Also TDS was filtered into a pre-weighed 250ml conical flask while TSS was measured using 50ml of each test sample and filtered through a pre-weighed filter paper (Whatman No. 541), and finally temperature measurements were undertaken with mercury in glass thermometer (centigrade ^0C).

Two microbial analysis of the sample were used such as faecal coliform count and total coliform count, both were incubated for 24 hours at 37^0C, using confirmed test plates of eosin methyl one blue agar for faecial coliform count while completed test of nutrient agar slant culture was used for total coliform count.

RESULTS

A total of 10 taxa of benthic macro-invertebrates representing 9 families were recorded from Elechi Greek Port Harcourt. Out of this number, 103 taxa from station 1 (Choba market), 30 from station 2 (Choba beach) and 25 from station 3 (Indomie) (Table 1). The significance of these results is suggestive of pollution of the Elechi Creek (Table 1) since station 3 was grossly polluted by Indomie effluent and refuse dumps as to inhibit all sensitive organisms with the exception of few species (Table 1). This account for low species in these station.

Also, the predominant species was *Tubificid* sp. under the class oligochaeta which has the highest mean density of $19.3m^2$ as shown in (Table 1). The species was present in all the stations. The lowest value recorded in the result was *Desmocaris trispinosa* which has the mean density of $1.3m^2$ (Table 1).

Table 1: Mean density (m^2) of organisms in the various sampling stations, in Elechi Creek, Port Harcourt.

Species	**1 Choba market**	**2 Choba beach**	**3 Indomie company**	**Mean (m^2)**
Nephtys sp.	6	1	-	2.3
Lumbrineresis triflelaris	2	-	3	1.7
Hirudo medicinalis	4	2	-	2.0
Limnobdella australis	8	2	-	3.3
Tubificid sp.	40	10	8	19.3
Libyodrilis sp	6	-	5	3.7
Desmocaris trispinosa	4	-	-	1.3
Gammarus sp.	3	6	2	3.7
Chironomus larvae	20	8	7	11.7
Caridin larvae	10	1	-	3.7
Total	**103**	**30**	**25**	

Table 2: Percentage composition of families and species in each class of benthic invertebrates collected

Class	Total no. of families	Total no. of species	Percentage species composition
Oligochaeta	2	2	20
Polychaeta	2	2	20
Hirudinea	1	2	20
Crustacean	3	3	30
Insecta	1	1	10
Total	9	10	100

The most dominant classes included the crustacean, which had the highest number of families (3) with 3 species. Oligochaeta and polychaeta had 2 families, with 2 species each while Hirudinea and insecta had a single family was represented with 2 and 1 species each. The class crustacean had the highest percentage composition (30%) while insecta had the lowest percentage value of (10%), each based on all species composition (Table 2).

The presence of these pollution indicator species is supported by the significant increase in BOD which ranged from 22.00mg/L to 60mg/L, COD (18.0mg/L – 54mg/L), TDS (20mg/L – 40mg/L), TSS (1270mg/L – 1360mg/L), DO (11.90mg/L – 12.08mg/L) and temperature (26.0^{0}C – 27.70^{0}C) (Table 3).

Table 3: The level of physico-chemical parameters on the distribution of macro-invertebrates

Parameters (mg/L)	Stations		
	1	2	3
Biological oxygen demand	24.64	60.00	22.00
Chemical oxygen demand	54.00	18.80	52.00
Total dissolved solid	40.00	20.00	28.00
Total suspended solid	1360.00	1280.00	1270.00
Dissolved oxygen	12.00	12.08	11.90
Temperature	27.70	26.60	26.00

The result further showed that faecal coliform had the highest value at station 1 (≥ 2400) and had the least value of 4 at station 3, while total coliform count has the highest value in the first two stations, station 1 (≥ 2400), 2 (≥ 2400) and had the least value in station 3 (1600) (Table 4).

Table 4: Microbial analysis of the sample

Samples/stations	1	2	3
Faecal coliform count	≥ 2400	14	4
Total coliform count	≥ 2400	≥ 2400	1600

DISCUSSION

Most taxa were recorded from a particular station which underscores the importance of such station while other stations recorded just few species. In terms of number and diversity more *Tubicifid* sp. were recorded from all the stations compared with station 3 that recorded just a few species, this was due to slow water current. Watling *et al*., (1974) pointed out that changes in water quality conditions, such as temperature regimes and dissolved oxygen concentration, can use a decrease in diversity and abundance of zoobenthic communities. He stated further that acute and chronic alterations in fresh water macro-benthic communities can also be caused by toxic pollutants from surface run-off, sewage discharge, industrial effluents and toxic materials such as ammonia, chlorine, heavy metals and phenols, which usually cause a decrease in the number of species and a shift in the species composition. This account for the fact that, the effect of deforestation due to dredging, erosion and habitat destruction could be responsible for the reduction in density of this organisms, since they usually occur in association with sea grasses and sea weeds in which the larvae feed (Hart, 1994).

Woke and Wokoma (2007) observed that certain euryhaline species may be absent in one biotope and instead be present in another and may occur in large numbers in the most ecological unpredictable zones.

It is important to find out if the discharge of organic waste (abattoir waste) influx has any significant adverse effect on the aquatic ecosystem. The measurable physico-chemical properties considered in this study were BOD, DO, COD, TSS, TDS and temperature. The concentrations of these parameters in natural aquatic ecosystem varied in response to abattoir waste influx. Waste biodegradation usually associated and responsible for such observed changes, BOD and COD observed in this study were generally higher than the standards allowed to be discharged into the Nigerian inland water (Last and Holland, 1998). Comparing these values with other findings made by Clerk (1986), they were greater than 4.0mg/L and therefore indicated high degree of pollution in the water body.

TSS and TDS of the samples was very high and this shows that both the abattoir waste water contains high quantities of organic and inorganic particles.

The observed fluctuation in temperature was considered normal with respect to the geographic characteristics of the Niger Delta which has been described as humid/semi-hot equatorial type (NEDECO, 1980). The low temperature recorded in this study is as a result of rainfall and flood inflow during the rainy season period which exerted some cooling influence. The effect was interfered with by the heat generated/absorbed during the metabolic processes of both waste biodegradation and aquatic organisms.

The values obtained for both faecal and total coliform counts for all the sample stations exceed the various standard suggested by United States Environmental Protection Agency for various water uses, thus, the Elechi Creek is highly polluted with faecal contaminants and as such unfit for domestic use.

In conclusion, pollution is due primarily to abattoir wastes, organic matter resulting from surface run-off coupled with particulates from erosion and sediments which contribute to high BOD and decrease in water quality. Hence sensitive organisms are eliminated allowing only pollution tolerant species to survive and multiply. Studies of this nature are important in enabling us understand the impact of organic waste (abattoir waste) especially in tropical waters where little is known.

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