FULL LENGTH RESEARCH ARTICLE

OIL SPILLAGE AND ITS IMPACT ON THE EDIBLE MANGROVE PERIWINKLE, *Tympanotonus fuscatus* Var Radula (L).

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ABSTRACT

Oil spills are a regular occurrence in the oil industry in Nigeria, a process that results in the release of excess hydrocarbons into the environment, negatively impacting plant and animal species. Laboratory and field experiments were conducted on refined oil impacted and fire ravaged mangrove ecosystem to determine the effect of oil spillage on the edible periwinkle *Tympanotus fuscatus*. The results showed that recolonisation occurred one year after the pollution. *Tympanotonus fuscatus* was observed in higher numbers than other organisms that attempted recolonisation. Bioassays carried out to investigate the response of *T. fuscatus* to the refined oil product showed a 96hr Lc50 value of 104.68ml/L.

Keywords: *Tympanotonus fuscatus*, impact, periwinkle, oil spillage, pollution

INTRODUCTION

Nigeria has a wide pipeline network and depots for distributing refined petroleum products in the country. The country has a total network of 5001 km of oil pipelines, consisting of 4315km of multiproduct pipelines and 666km of crude oil pipelines (Brume, 2004). These pipelines criss-cross the country and interlink the twenty-two petroleum storage depots strategically located across the country all linked to the refineries at Port-Harcourt, Kaduna, Warri, the offshore terminals at Escravos and Bonny as well as the four jetties at Okrika, Atlas cove, Warri and Calabar. For reasons of safety and security, the pipelines are buried about one meter beneath the earth's surface.

Most of these pipelines are old and poorly maintained, resulting in corrosion and leakages that bring about oil spills (Brume, 2004). More recently due to poverty and indiscipline, some Nigerians vandalize these pipelines to siphon their products to sell illegally. Most oil spillage results are followed by fire that destroys vegetation and animal life. The fire outbreaks associated with petroleum products spillage usually cause more damage to the environment than the petroleum products spill alone (Dwire & Kauffman, 2003, Otitoloju & Are 2003). On the 16th of September 2004, an oil pipeline in Imore village in Lagos State, Nigeria was vandalized, resulting in the leakage of petrol to the environment and followed by a massive fire outbreak that destroys more than 5 km^2 of the area. Benthic macro invertebrates such as crustaceans and mollusks as well as other organisms were killed. This study was carried out to investigate the impact of the oil spill on the population density of the edible periwinkle *Tympanotonus fuscatus*.

MATERIALS AND METHODS

Study site: The study site is a part of Imore village in Oriade Development Area of Lagos State. It is located East of Port-Novo creek between longitudes N0.60.25.496' and latitude E0030.16.73.

Sampling design: The impacted area at Imore village was divided into approximately 4 equal imaginary zones A,B,C and D, away from the epicenter of the spill. In an attempt to show the presence of a pollution gradient, a fifth zone E (at Ibasa village) was chosen to serve as control. Two sampling stations were chosen randomly per zone as replicates, within which samples were taken. Sampling was carried out twice in a month.

Chemical characteristics of sediment samples: In each of the sampling stations, sediment samples were collected and the following parameters were determined; Total hydrocarbon content (THC), and Lead (Pb).

Ecological survey: In each of the sampling stations, *Tympanotonus fuscatus* counts were carried out within a specified area, to determine their abundance.

Test animal: *T. fuscatus* of similar sizes (shell length of 28-32mm) were used in this study. Live samples were handpicked and taken to the laboratory, where they were kept in holding glass tanks (30cm x 30cm x30cm) aerated with lagoon water.

Test chemical: Premium Motor Spirit (PMS) otherwise called petrol was used as the test chemical.

Preparation of substrate: Sediments from the site of collection were used as substrates and prepared after Tokolo (1998) to standardize the grain size.

Acute toxicity of petrol against Tympanotonus fuscatus: Ten test animals were introduced randomly into treated and untreated test media. Each treatment was replicated twice as follows; 55, 58, 60, 80, 100, 120, 140, 160, 180, 200, 220, 250, 280, 300ml/l and untreated control. Mortality assessments were carried out once every 24 hrs for 4 days.

Statistics (Dose – response analysis): Toxicological data involving quantal response for single action studies were analysed using probit analysis (Finney, 1971).

The indices of toxicity measurement derived from the analysis were LC95, LC50, LC5 and toxicity factor (factor for relative potency measurements).

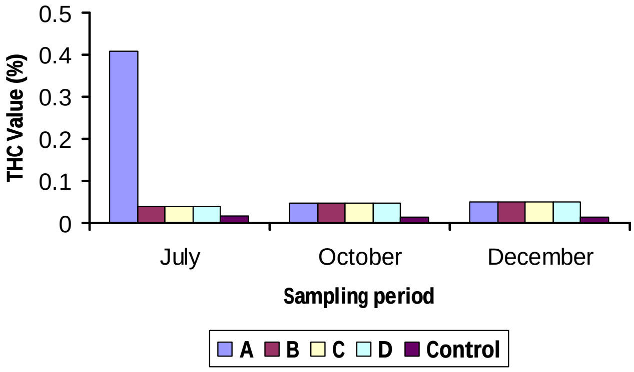
RESULTS

The changes in chemical parameters studied on the sediment samples are as presented in Table 1 and Figs. 1 and 2.

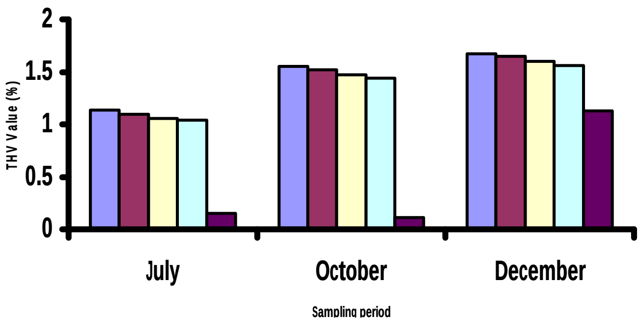
TABLE 1. CHANGES IN CHEMICAL PARAMETERS IN SEDIMENT SAMPLES FROM STUDY SITES.

THC (%)	JUL	OCT	DEC
	30cm	30cm	30cm
A	0.407	0.0481	0.0509
B	0.0398	0.048	0.0505
C	0.0394	0.0475	0.0504
D	0.039	0.0467	0.0498
CONTROL	**0.0156**	**0.0133**	**0.0134**

LEAD (mg/kg)	JUL	OCT	DEC
	30cm	30cm	30cm
A	1.14	1.55	1.67
B	1.1	1.52	1.65
C	1.06	1.47	1.6
D	1.04	1.44	1.56
CONTROL	**0.15**	**0.11**	**0.13**



A



B

FIGS 2A SHOWING CHAMGES IN THC AND FIG 2B SHOWING CHANGES IN LEAD CONTENT IN THE SAMPLING ZONES

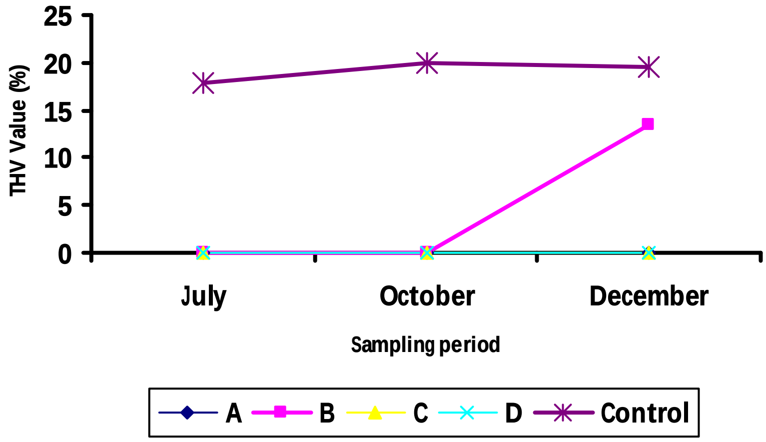


FIG 3. CHANGES IN *T. Fuscatus* NUMBERS OBSERVED AT THE STUDY AREAS.

TABLE 2. ACUTE TOXICITY OF PETROL TESTED AGAINST *T. fuscatus.*

Time (hrs)	LC50 (95% CL)ml/l	LC95(95% CL) ml/l	LC5 (95% CL) ml/l	Slope±S.E	Probit equation	T.F
24	-	-	-	-	-	0
48	166.974(138.188 – 201.841)	527.112 (324.268 – 853.838)	52.892 (36.084 – 77.869)	3.305 ± 0.578	Y = -2.345 + 3.305x	1.00
72	123.717 (106.361- 143.901)	307.969 (229.041 – 412.523)	49.700 (36.804 – 67.365)	4.166 ± 0.600	Y = -3.716 + 4.166x	1.34
96	104.682 (91.733 – 119.455)	210.089 (168.047 – 261.819)	52.160 (41.401 – 65.919)	5.454 ± 0.740	Y = -6.016 + 5.454x	1.59

DISCUSSION

The results from this study showed that Total Hydrocarbon C (THC) content ranged between 0.0407 and 0.0509, while Lead Concentrations (LH) ranged between 1.14 and 1.67, at the epicenter of the spill. At sampling points further away from the epicenter, (THC) and (LH) ranged between 0.039 and 0.0498, and 1.04 and 1.56 respectively. Results showed higher levels of total hydrocarbon, and lead at the sampling station closest to the spill. In this study, it was observed that the oil spill and ensuing fire incidence had a severe negative effect on the population of *T. fuscatus* at the impacted site. There was a complete absence of this species in all the impacted sites. This could be as a result of the extent of the spill and magnitude of the fire that followed. Otitoloju & Don-Pedro (2004) had earlier observed a complete destruction of both plants and animal community following a petroleum product spillage and fire ravaged ecosystem at the Atlas cove jetty. Much earlier study by Samuel (1998) also observed an adverse effect on the population density and diversity of animal species in same area.

It is note-worthy that *T. fuscatus* was found in the zone closest to the epicenter of the spill, probably an indication of high tolerance levels to petroleum hydrocarbons. The study also revealed a complete absence of *T. fuscatus* at the beginning of the survey. However, towards the end of this study, this species began to recolonise the impacted site as indicated in Station B which is next to the epicenter of the oil impacted zone (Fig 3).

The effects of fire on benthic species have been reported. Minshall (2003) observed that the extent of mortality depends on intense heat, extended exposure to dense smoke and errant retardant drops. Results from this study suggested that the heat from the fire must have been intense. This is based on the fact that there was extensive damage to the mangrove ecosystem and fire raged for about one week before it was put out. The population of *T. fuscatus* at the spill sites was by far

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less than the population at the control zone.

The results from sediments samples show a marked difference in the hydrocarbon content levels at the impacted site, especially at the epicenter of the spill, where the hydrocarbon content was two times the level at the control site. In conformity to this, the study at Atlas cove jetty by Otitoloju *et al.,* (2006) observed that the THC levels in sediments collected from the impacted stations were generally higher (0.78 – 3.67mg/l) than the levels detected in the control stations (0.13 – 0.18mg/l). Added to this were lead concentrations, which were found to be three times the level at the control site. These properties most likely added to the initial absence of this species and a gradual recolonistaion of the impacted zone.

On the basis of the 96hr-LC50 values, the response levels of *T. fuscatus* showed that it was tolerant to PMS and the tolerance level was significantly high (no overlap in 95% confidence limit of 96hr – LC50 fact that the spilled product (petrol) is volatile. This could be attributed to the fact that by the end of the study, THC, and Lead concentrations were still high, as compared to the control site and that the fire burnt the top soil, thus reducing the hydrocarbon content level, as well as the sandy nature of the soil, which increased percolation, resulting in greater amounts of THC penetrating deeper into the soil.

There is the need to evaluate the response of this species to different concentrations of PMS to determine the acute toxicity to this species and to determine its tolerance level. Sublethal effects should also be determined as this could lead to shifts in community structures (Hawkins *et al.,* 2002), rising and crashing of population of dominant species, high amplitude oscillations and complex interactions between species in the community on the long-term basis. This study has brought out the need for implementation of an environmental impact assessment by which baseline ecological survey must be carried out. A long term quantitative monitoring should be carried out to ensure that measures put in place to protect our environment are adequate.

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