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COMPARATIVE TOXICITY OF PETROL AND KEROSENE TO PERIWINKLE (*TYMPANOTONUS FUSCATUS*)

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ABSTRACT

The comparative toxicities of two petroleum products, petrol and kerosene were examined by exposing *Tympanotonus fuscatus* to acute concentrations (60, 90, 120 and 150ml/L) of these toxicants for 96 hours. The 48th hour LC_{50} for petrol was 177.36 ml/L, while that of kerosene was 306.16 ml/L. The 96th hour LC_{50} was 34.12 ml/L for petrol as against 111.14 ml/L for kerosene. The 48th hour LC_{50} of petrol was found to be 2.40x that of the kerosene, while the 96th hour LC_{50} was found to be 3.25x the value observed in the kerosene. The 48th and 96th hour LC_{95} for petrol was 317.88 and 99.54ml/L while that of kerosene was 1079.11 and 433.94 ml/L. The mean lethal time (MLT_{50}) of petrol in the various concentrations were 61.64, 68.09, 44.71 and 43.17 hours for 60, 90, 120 and 150 ml/L respectively. The MLT_{50} of kerosene in the Various concentrations were 90.13, 84.06, 79.02 and 73.27 hours for 60, 90, 120 and 150 ml/L. There was a time and concentration dependent mortality of *Tympanotonus fuscatus* in both media. The mortality rate in petrol was found to be higher than that of the kerosene in all situations. The results suggests that both petrol and kerosene are toxic to the environment with petrol being more toxic than the kerosene.

KEYWORDS: Petrol, kerosene, *Tympanotonus fuscatus*, toxicity, environment.

INTRODUCTION

Petrol and kerosene are refined petroleum products which contains hydrocarbon mixtures of 5-18 carbon atom chains per molecule. Petrol being the lighter fraction ranged from 5-10 carbon chains while kerosene ranged from 11-18 carbon atom chains. They are volatile with petrol being more volatile than the kerosene. They are volatile liquids used as fuel for cars, automobiles, generators, heating or cooking at home, driving of jet aeroplanes etc, and are also used as solvents for paints and greases (Jumoke, 1999; Amakiri *et al*., 2009). There is a growing critical interest in the effects of crude oil and its fractions as a result of increased incidence of oil pollution which may have resulted from spillages, leakages due to corrosion of pipes, vandalisation and other forms. According to Dange and Masurekar, (1981) most studies on the effects of oil pollution in the aquatic environment deals only on the effects of whole crude or the refined fractions. Most of these studies are carried on fishes (Nwamba *et al*., 2006; Chukwu and Okhumale, 2009) which can easily swim away from the polluted area to free zones. Crude oil and its products infilterates the aquatic ecosystem and thereby cause great damages to the aquatic environment in a number of ways. One of such ways is the limiting the amount of oxygen available to aquatic flora and fauna (Nwamba *et al*., 2006) and secondly can directly interfere with the biochemical and physiological activities of the organism in contact (Tatem, *et al*., 1979; Dange and Masurekar, 1981).

Moreover, according to Chukwu and Okhumale, (2009) generic standards of the various crude fraction toxicities are not available and therefore it becomes necessary to determine the concentrations at which they become toxic to the environment and also to make comparison of the toxicities of the individual components of the crude so that adequate standards and proper legislation can be put in place.

The potential toxicities of crude fractions, dose response relationships to sensitive species should be established (Mason, 1992) especially with very slow moving species such as the mollusks. The establishment of such relationship will help the environmentalist/ government to effectively put in place standard regulations and warnings where necessary and also the rural dwellers who pick periwinkles for consumption as protein source and commercial purposes.

This study was therefore undertaken to evaluate the effects of petrol and kerosene on the mortality of periwinkles (*Tympanotonus fuscatus*) and to compare their toxicities on same specie.

MATERIALS AND METHODS

Periwinkles (*Tympanotonus fuscatus*) of size between 4.5 - 5.5cm were handpicked at the Eagle Cement area of the New Calabar River near the Ignatius Ajuru University of Education Rumuolumeni, Port Harcourt. They were transported in plastic buckets to the Chemistry Department Laboratory of the University. Two hundred apparently healthy periwinkles were acclimated to laboratory conditions in plastic tanks of six litre

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capacity. The tanks were half filled with brackish water and sediments collected from same source. The acclimation was done for seven days. The substrate was prepared by air drying the sediment and then macerated in a mortar and sieved in 2mm mesh.

Two hundred and fifty grams (250g) of finely prepared sediment were put into each of the plastic tanks of aqueous/ toxicant mixture to serve as the substrate base. Completely randomized design (CRD) was used for the experiment. The experiment was divided into five treatment levels with three replicates. The test media petrol were prepared in the following concentrations: 30 ml/L, 60.0 ml/L, 90.0 ml/L, 120.0 ml/L, and 150.0 ml/L of petrol and those of the kerosene were prepared in the following concentrations: 60.0 ml/L, 90.0 ml/L, 120.0 ml/L, 150.0 ml/L and 200ml/L of kerosene. These concentrations were arrived at after series of trial tests and also from the LC_{50} of 104.68ml/L observed by Renner *et al*., (2008). Ten of the test animals were introduced into each of the toxicant media. Dead periwinkles were ascertained if the animal has completely retracted into the shell or if it fails to respond to prodding of a glass rod for a period of 15minutes. Mortality assessment was carried out at defined intervals of 24, 48, 72 and 96 hours.

STATISTICAL ANALYSIS

The data obtained were subjected to analysis of variance (ANOVA) to determine if significant differences ($P<0.05$) existed between the means in the mortality at different levels of contamination. Where differences existed, Duncan's multiple range test (DMRT) was used to compare the means (Zar, 1984). Toxicological response data involving quantal response (mortality) was analysed using probit analysis (Finney, 1991) to determine the lethal concentrations (LCs) and lethal time (MLTs).

RESULTS

The mean lethal concentrations (LC_{50}) of petrol and kerosene to *Tympanotonus fuscatus* was time dependent. In the aqueous solutions of the two toxicants, petrol had lower LC_{50} of 127.36, 64.83 and 34.12 ml/L as against that of kerosene, which were 306.16, 191.02 and 111.14 ml/L for 48, 72 and 96 hours respectively in each case. The LC_{95} for the various toxicants were 317.88, 181.99 and 99.54 ml/L for petrol, while that of kerosene was 1079.11, 726.96 and 433.94 ml/L for 48, 72 and 96 hours respectively in each case (Table 1).

The mean lethal time (MLTs) were dose dependent. The MLT_{50} for petrol and kerosene in the 60ml/L concentration was 61.64 and 90.13 hours respectively. In the 90 ml/L concentration, the values obtained were 68.09 and 84.06 hours for petrol and kerosene respectively. The MLT values obtained in the 120 ml/L concentration were 44.71 and 79.02 hours for petrol and kerosene respectively. The 150 ml/L MLT_{50} for petrol was 43.17 hours as against 73.27 hours for the kerosene. The MLT_{95} for petrol were 123.89, 110.07, 87.46 and 84.18 hours for 60, 90, 120 and 150 ml/L respectively. The MLT_{95} values for kerosene were 173.62, 159.59, 154.70 and 144.06 hours for 60, 90, 120 and 150 ml/L respectively (Table 2).

The mean mortality of *Tympanotonus fuscatus* in petrol and kerosene solutions showed that the mortality was time and concentration dependent. However, higher mortality rate was recorded in the petrol media than that of the kerosene media. The mortality was found to be significantly different ($P<0.05$) at the various time in and concentrations between the two solutions (Table 3). The log transform of the mortality is indicated in Table 4.

Table 1: Comparative lethal concentrations (mL/L) of petrol and kerosene to *Tympanotonus fuscatus* after 96 hours exposure.

Exposure	Lethal concentrations (ml/L) with associated 95% confidence interval					
	Petrol	Kerosene	Petrol	Kerosene	Petrol	Kerosene
Duration (hrs)	LC_{50}	LC_{50}	LC_{90}	LC_{90}	LC_{95}	LC_{95}
48	127.36	306.16	275.80	731.97	317.88	1079.11
72	64.83	191.02	156.11	486.26	181.99	726.96
96	34.12	111.14	85.09	289.00	99.54	433.94

Table 2: Comparative median lethal time (MLT) of Petrol and Kerosene to *Tympanotonus fuscatus* after acute exposure.

Concentration of Petrol/ Kerosene (mL/L)	Median lethal time (hrs) and associated 95% confidence interval					
	Petrol MLT_{50}	Kerosene MLT_{50}	Petrol MLT_{90}	Kerosene MLT_{90}	Petrol MLT_{95}	Kerosene MLT_{95}
60	61.64 (30.13-86.41)	90.13 (52.94-126.45)	110.82 (90.09-147.50)	155.18 (120.89-272.16)	123.89 (102.41-173.23)	173.62 (139.16-319.46)
90	68.09 (29.35-75.58)	84.06 (61.40-110.58)	99.48 (85.56-123.73)	139.84 (-)	110.07 (94.65-140.81)	159.59 (-)
120	44.71 *(22.98-58.30)*	79.02 (42.00-105.06)	78.02 (63.85.96.26)	137.99 (101.68-214.05)	87.46 (93.07-109.16)	154.70 (123.42-251.68)
150	43.17 (16.95-56.30)	73.27 (40.74-96.30)	75.00 (60.20-93.29)	128.43 (104.14.138.80)	84.18 (69.60-105.59)	144.06 (116.63-214.09)

Table 3: Mean mortality of *Tympanotonus fuscatus* of different concentrations of Petrol and Kerosene After acute exposure.

Time Duration (Minutes)	Concentration of petrol and kerosene in mL/L							
	Petrol 60	Kerosene 60	Petrol 90	Kerosene 90	Petrol 120	Kerosene 120	Petrol 150	Kerosene 150
24	2.67 ± 1.01^a	1.33 ± 0.11^b	2.00 ± 0.00^a	1.67 ± 0.36^a	3.33 ± 1.23^a	2.00 ± 0.00^a	3.67 ± 1.11^a	2.33 ± 1.01^a
48	4.67 ± 1.74^a	3.33 ± 1.23^b	4.00 ± 1.25^a	3.67 ± 1.11^a	5.00 ± 0.95^a	5.00 ± 1.05^b	4.67 ± 1.24^a	$4.00 \pm 0,00^a$
72	6.33 ± 0.55^a	4.67 ± 1.56^b	6.33 ± 0.67^a	4.00 ± 0.45^b	7.00 ± 0.00^a	5.33 ± 1.23^b	8.00 ± 0.00^a	5.33 ± 1.88^b
96	8.33 ± 1.54^a	6.33 ± 1.67^b	8.00 ± 0.00^a	5.33 ± 1.34^a	9.67 ± 2.01^a	5.67 ± 1.10^b	10.00 ± 0.00^a	7.33 ± 2.31^b

Means with the same alphabet in the same row are not significantly different (P>0.05)

Table 4: Log transform of total mortality of *Tympanotonus fuscatus* of different concentrations of Petrol and Kerosene After acute exposure.

Time Duration (Minutes)	Concentration of petrol and kerosene in mL/L							
	Petrol 60	Kerosene 60	Petrol 90	Kerosene 90	Petrol 120	Kerosene 120	Petrol 150	Kerosene 150
24	0.9	0.6	0.78	0.7	1.0	0.78	1.04	0.85
48	1.15	1.0	1.08	1.04	1.18	1.18	1.15	1.08
72	1.28	1.15	1.28	1. 08	1.32	1.20	1.38	1.20
96	1.40	1.28	1.38	1.20	1.46	1.23	1.48	1.34

DISCUSSION

The mortality of organisms in the face of adverse environmental conditions is based on the certain factors such as: the chemical, the concentration of the chemical, the species in contact and the environment (FAO, 1981). However, for mortality of an organism to occur in the face of environmental pollution, contact of the organism with the toxicant must be established, the toxicant then exerts its effect on the organism, the organism begins to loss equilibrium or balance and finally the organism dies of exhaustion resulting from stress and distress (Besch, 1975). In each of these phases that lead to death of the organism, physiological and biochemical alterations occur within the organism, thereby eliciting different types of reaction to counter the effect of the toxicant. In general, petroleum products exerts their toxic action or mortality on organisms by limiting the amount of oxygen available to organism through the coating of respiratory surfaces such as skin, gills and spiracles of exposed organism (Hosmer et al, 1998; Chukwu and Odunzeh, 2006).

In another study, it was observed that the effects of petroleum pollution on crustaceans are largely determined by the proportion of toxic components, the duration of oil exposure and the degree of other stresses (NRC, 2002). Animals may be exposed to petroleum compounds by inhalation, direct contact with the skin, or ingestion. In addition to outright toxicity, the threat posed to aquatic species by the persistent residues of spilled petroleum sludge and other petroleum products in water is one of physical smothering (Brassard, 1996). In a survey, National Geographic (2000) observed that petroleum sludge pollution in the environment affects organisms by direct physical coating, alteration of essential elements of the habitat, and by the direct toxic effects of the chemicals. It also rapidly penetrates into the species through gills and disturbs the body systems such as respiration, nervous system, blood formation and enzyme activity. The occurrence of this disturbance leads to a number of common symptoms like behavioral change and loss of oxygen due to the sludge pollution (Hosmer et al., 1998).

The 96th hour LC_{50} and LC_{95} values obtained for *Tympanotonus fuscatus* in petrol (34.12 ml/L and 99.544 ml/L) and kerosene (111.14 ml/L and 433.94 ml/L) is an indication that petrol is more toxic to this specie than the kerosene. On the basis of the $LC_{50,}$ it shows that petrol is about 3.26 times more toxic to *Tympanotonus fuscatus* than the kerosene. The 150 ml/L concentration MLT_{50} for petrol was 43.17 hrs as against that of the kerosene which was 73.27 hrs, thus implying that it takes the kerosene about 1.7 times to effect the same mortal damage as the petrol to this mollusk. It also may mean that the *Tympanotonus fuscatus* is more sensitive to the petrol than the kerosene. According to Buikema (2000) and Tudararo-aherobo *et al*., (2013), the higher the LC_{50}, the lower the toxicity to the test organism.

The observed LC_{50s} for both petrol and kerosene in this study were found to be higher than the values of 911.57ml/L observed by Chukwu and Odunzeh, (2006) when they exposed periwinkles to spent engine oil. However, the authors observed the mortality of periwinkles exposed to detergents to have LC_{50} of 48.67mg/L which was higher than the value observed for petrol but lower than the value observed for kerosene. The value observed in this study for petrol (34.12ml/L) contradicts that observed by Renner *et al.,* (2008) which was 104.68ml/L when they exposed periwinkles to petrol, even though the value was slightly higher than that of the kerosene.

The difference in mortality may be due to the relative differential toxicity of the petrol and kerosene. This statement is corraborated by Bobmanuel *et al*., (2006) in their observation of the response of three different fish species to fertilizer effluents. Difference in mortality can also result from the response of the relative activity levels and tolerance of the *Tympanotonus fuscatus* to the toxicant, which corraborates the findings of Bury et al., (1999) when they exposed rainbow trout to various concentration of silver. The observed differential toxicities between the petrol and the kerosene can also be attributed to the differences in physical characteristics and chemical composition of the two products (Nelson-Smith, 1990; Westermeyer, 1991). It has been observed that both physical and chemical properties play active roles in the rate of penetration of active components into the organs of living organism and the mode of action on organ metabolites which then determine the toxicity action that is exerted on the organism (Chukwu and Odunzeh, 2006).

In a similar study, *Edori et al*., (2014) exposed *Tympanotonus fuscatus* to different concentrations of petrol and diesel and observed that petrol caused more serious enzymatic alterations in the mollusk than the diesel and attributed this differential toxicity to the difference in the volatility of the products. In the same vein, the greater mortality of *Tympanotonus fuscatus* in the petrol media than the kerosene can also be attributed to volatility of the components. The more volatile components have more penetration power into the organs of organisms than the less volatile component.

CONCLUSION

From the observed mortality and the LC_{50} for both petrol and kerosene, it follows that kerosene is less toxic to periwinkles than the petrol. Moreover, the presence of these hydrocarbons in the aquatic environment will cause enormous amount of damage to aquatic animals especially the periwinkle. If the condition is allowed to persist, it can likely cause a drift in the population of this species in the environment and most likely will affect the economic position of the rural dweller and also their protein intake since periwinkle is a source of protein for them. Therefore adequate legislative measure be taken to protect the environment from avoidable spills and where it happens, adequate clean-up measures be taken immediately to avoid mass mortlity and extinction of this specie from the ecosystem.

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