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Studies on the Toxicity of Crude and Refined Oil on Nile Tilapia (*Oreochromis niloticus* Linnaeus 1858)

[1]Umar, A., [2*]Modu, B. M., [1]Abdullahi, A., [1]James, T., [1]Ahmed, A., [1]Abubakar, U., [1]Kucheli, M., [1]Harira, G and Ibrahim, I.

[1] Department of Biological Sciences, Faculty of Sciences, University of Maiduguri.
[2] Department of Fisheries, Faculty of Agriculture, University of Maiduguri.

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ABSTRACT

This study was conducted using post fingerlings of Nile tilapia (Oreochromis niloticus L.) for the different toxic concentrations of crude and refined oil. The fish were obtained from the Department of Fisheries University of Maiduguri Fish Hatcheries. Data obtained were analyzed using Stats-direct Version 2013. Results indicated significant differences with most of the toxicants. ($P < 0.05$).The experimental fish showed different percentage mortalities with toxicant concentrations.The crude oil had more deleterious effects on the fish (both juveniles and post fingerlings) then other products of the crude oil. Although all most all the post-fingerling fish in all the treatments were mostly affected by both crude oil and refine oil. The present study indicates that pollution induces by crude oil and its products are more detrimental to tilapia survival over a short pollution period than and other pollutant over time. The study also shows that to certain extends that crude and refine oil pollution can disturbed the entire ecosystems in a short period of time.

Key words: Toxicity, Crude oil, Refine oil, *Oreochromis niloticus*

INTRODUCTION

Crude and refined oil pollution is one of the major environmental problems for all aquatic organisms (Agbogidi *et al*., 2005). Crude oil and its products are well-known for their stressful effects to fin fish and other shelled-fish in the coastal areas (Azad, 2005). The frequent spillage of crude oil and its products in some coastal areas have been reported for some remarkable reduction in the number of fish assemblage in both inland and open sea fisheries (Ogundiran, *et al*., 2010). Azad, (2005) reported that eggs and young fingerlings of fishes are the most vulnerable to the toxic effects of crude oil and its refined products. According to Ubong *et al.* (2015) crude oil and other oil products concentrations of 0.01 mL/L are known to accelerate the death of fish in aquatic ecosystems. In Nigeria, many water bodies are being polluted as results of oil and oil products exploitation especially in the Niger Delta region. Ek *et al*. (2005) reported that Fish responses to petroleum contaminants in Nigerian aquatic environment have been used as biomarkers of aquatic pollution which mainly are detected in water sediment and fishes themselves. The major effects of Crude and refined oil on fish and shelled fishes depends on numbers of factor either individually or in combination (Adewoye, 2010). Factors such temperature, pH, dissolved oxygen, Alkalinity and Hardness induces fishes to change their reproduction and behavioral pattern.

Tilapia is the common name for nearly a hundred species of cichlid fish from the tilapia cichlid tribe. Tilapia are mainly fresh water fish inhabiting shallow streams, ponds, rivers and lakes, and less commonly found living in brackish and marine waters (Nwanba *et al*., 2001). Crude oil pollution has adverse effects on Tilapia fingerlings as they swim away from heavy oil pollution and particularly from oil spills riverine areas, where the oil spills on the water body causes decrease in photosynthesis and consequently a lowering of dissolved oxygen levels in water (Omoregie and Ufodike 2000).

*Corresponding Author email: mammadu09@gmail.com, Tel: +234 8034671898

The slimy mucus on the gills of fish makes them somewhat resistant to oil (Ufodike and Omoregie, 1991). However, there is much evidence that fish are adversely affected by both spilled petroleum and chronic pollution by refined petroleum products (Omogere *et al.*, 2006). The chemical agent or toxicant can produce an adverse effect in a biological system which may cause either through an alteration of normal function or the destruction of life entirely (Agbogidi *et al.*, 2005).

MATERIALS AND METHODS

The study site

The study was conducted in the Department of Biological Sciences, Faculty of Science University of Maiduguri located between latitude 13^0N and longitude 11^0E in the North-Eastern part of Nigeria, with annual mean temperature ranged from 5^0C to 47^0C, and the annual relative humidity ranged from 39% to 60% (CBDA, 1984).

Source of Nile Tilapia

A total number of one hundred and thirty-five (135) Nile tilapia (*Oreochromis niloticus* L.) post fingerlings weighing 25 – 40 g and 5 – 10 cm in size were obtained from Department of Fisheries, Faculty of Agriculture, University of Maiduguri. The fish were kept in a plastic bowl (60 cm in diameter) containing their original tank water before changing the water for further study.

Source of crude oil and toxicant preparation

The crude oil was obtained from Mobile Oil Company in Lagos in an airtight plastic container and transported to Maiduguri. However, the other fractions such as Dual Purpose Kerosene (DPK), Automotive Gas Oil (AGO) and Premium Motor Spirit (PMS) were purchased at commercial felling station (Oando) near by the University of Maiduguri. The toxicant solution was prepared by mixing the crude oil and other by-products with tank water. The mixture was then vigorously shaken and filtered to obtain a homogenous toxicant which was allowed to settle for eight hours.Water quality parameters such as Temperature, Dissolved oxygen, pH, and Ammonia were monitored daily according to method described by ALPHA (1998).

The test procedure

The fish were separated into 3 groups and each was replicated three times the forth group was being the control. Each replicate pen had 5 fish contained in a transparent white container with 5 litres of clean tap water, the water pH was 6.8 and varying levels of crude oil or refined petroleum products (PMS, AGO and DPK. 0.0ml, 0.2ml, 0.4ml, 0.6ml of crude oil) were added to the containers. The fish were fed at 5% body weight with commercial fish food sprinkled on the water surface before the experiment. Feeding of fish was suspended on the first experimental day to avoid waste concentration. The treatment containers were covered with untreated mosquito nets to prevent fish from escaping. The mortality of the fish was counted after exposure at 24, 48 and 72 hours.

Data analysis

The Probit analysis was done using Statsdirect (2013) statistical software to determine the lethal concentration that kills 50% of exposure. Graphpad (2000) to perform analysis of variance (ANOVA) at $P<0.05$ to test the significant difference in the experiment.

RESULT

Behavioral changes and fish kill were observed in the fish examined. Changes such as difficulties in breathing, loss of balance, and some erratic swimming were clearly experience by the experimental fish. Probit analysis for crude and refined oil is presented in Table 1. Results show in a degraded pattern during the first day of exposure that toxicity of Crude oil was greater than AGO then DPK and followed by PMS in that respects. However, fish exposed to these oil products at the second day manifested some adverse characters such slow swimming, poor food intake and engulfing free air at the water surface.

Table 1: Probit analysis for crude and refined oil

Treatment	Lethal concentration	Days after treatment	
		1	2
		Concentration (ml/L)	
Crude oil	LC_{50*}	0.43 (0.3I-1.66)**	0.23 (0.13-0.30)
Pms	LC_{50}	0.24 (0.14-0.31)	0.27 (0.10-0.36)
Kerosene	LC_{50}	0.25 (0.04-0.36)	0.13 (1.87-0.21)
Diesel	LC_{50}	0.40 (0.22-4.16)	0.23 (0.04-0.32)

** LC_{50}=Lethal concentrations that kills 50% of Fish. Number in parenthesis is 95% confidence interval

The mortality effects of crude oil on *O. niloticus* post fingerlings are presented in Table 2. At the first day of exposure, there was a significant difference between control and 0.2ml/L and also between 0.4 and 0.6m/L respectively ($P < 0.05$). However, at the second day after treatment there was also a significant difference ($P < 0.05$) between control and all other concentrations.

The mortality effects of PMS on *O. niloticus* post fingerlings are also presented in Table 2. At day one after treatment there is an apparently significant difference ($P > 0.05$) between control and 0.2ml/L and also between 0.4 and 0.6m/L respectively. At days two after treatment there is significant difference ($P < 0.05$) between control and all concentrations.

Table 2: Mean mortality effects crude oil and refined oil products on *O. niloticus* post fingerlings

Test Products	Days After Exposure	Concentration (ml/L)			
		0.0	0.2	0.4	0.6
Crude oil	1	0.000^{a}*	0.6667^{ab}	1.667^{bc}	2.667^{c}
	2	0.000^{a}	2.000^{b}	4.000^{cd}	4.667^{d}
PMS	1	0 .3333^{a}*	2.000^{ab}	3.333^{bc}	5.000^{c}
	2	0.3333^{a}	2.333^{bc}	3.667^{cd}	5.000^{d}
DPK	1	0.000^{a}*	2.000^{b}	3.333^{cd}	4.000^{d}
	2	0.000^{a}	3.667^{bc}	4.333^{cd}	5.000^{d}
AGO	1	0.000^{a}*	1.333^{bc}	2.000^{c}	3.333^{d}
	2	0.000^{a}	2.333^{bc}	3.000^{c}	4.667^{d}

*Column means bearing the same letter are not significantly different using Turkey Kramer multiple comparison test.

The mortality effects of DPK on *O. niloticus* post fingerlings are presented in Table 2. At the first day after treatment there is no significant difference ($P > 0.05$) between control and 0.2ml/L and also between 0.4 and 0.6m/L respectively. At the second day after treatment there is significant difference ($P < 0.05$) between control and all concentrations.

The mortality effects of AGO on *O. niloticus* Post fingerlings are presented in Table 2. At the first day after treatment there is no significant difference ($P > 0.05$) between control and 0.2ml/L and also between 0.4 and 0.6m/L respectively; while at the second day after treatment there is significant difference ($P < 0.05$) between control and all concentrations. However, this shows that almost all the fish exposed to those concentrations have some significant effects on the survival of the fish.

DISCUSSION

The present study evaluates the toxicity of crude and refined petroleum products (PMS, AGO AND DPK) on post fingerlings of *O. niloticus.* Higher mortality recorded in the present study might be due to blockage of atmospheric oxygen from dissolving into water thereby limiting the supply of dissolved oxygen use by the fish fingerlings as reported by Azad (2005). Thus resulting into high incidence of excretory waste products (notably carbon dioxide and ammonia) in the water and decreased in dissolve oxygen (DO) concentration (Nkwelang *et al.* 2009). Similar report was presented by Ogundiran *et al.* (2010) when investigating toxicological impacts of detergent effluent in fingerlings of African catfish *Clarias gariepinus*.

The high mean mortality derived from this experiment is similar to findings of Ubong *et al*. (2015) who's studied similar fish (tilapia) and found out that considerable percentage mortalities of fish were concentrations dependent. Out of all the treatments, crude oil is more effective in causing the fish mortality than, AGO, DPK and PMS thus similar to that of Nwamba *et al.* (2001). In all the treatment no tilapia post fingerlings survived beyond two days after exposure. This contradict the findings of Ekanem *et al.* (2011) who reported that fresh water quality near the oil spill is suitable for survival and growth of sensitive stages of some aquatic organisms.

Conclusions

From the present studies it concluded that crude oil is more toxic to Nile tilapia (*Oreochromis niloticus*) post fingerlings as compared to other treatments studied. Hundred percent (100%) mortality was recorded on the third day of exposure to crude. The study also indicates that crude oil pollution could be beneficial to tilapia fish at certain sub lethal doses. Hence, stress due to sub lethal pollution could enhance the fish defense mechanism. Young tilapia fish such as fingerlings and post fingerlings were less tolerance to crude oil pollution the present study. However, since Nile tilapia is an important aquaculture fish in the developing countries including Nigeria, there is need for researchers to emulate prevention technique from developed nations where environmental monitoring agencies are more effective and environmental laws and legislations are strictly adhered to. The calculated indices from this study, such as Shannon-Weaver (H'), Simpson index (1/D), Margaleff Diversity Index (M), Mackintosh Diversity Index (D & E) and Berger-Parker dominance Index (1/d) apparently revealed that the diversity and distribution of the five monogenean gill parasites in their respective fish hosts were affected by the water quality variables and seasonality during the study period.

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