Direct Research Journal of Public Health and Environmental Technology

Direct RESEARCH JOURNALS

Vol.3 (5), pp. 68-72, September 2018
ISSN 4372-2603
DOI: https://doi.org/10.26765/DRJPHET.2018.8159
Article Number: DRJA631708159

Direct Research Journal of Public Health and Environmental Technology
http://directresearchpublisher.org/journal/drjphet/
Research Paper

Effect of Oil Spillage on Catfish (*Clarias gariepinus*) in the Aquatic Water Body Nigeria

Matur, B. M., Solomon J. R*. and Ameh, U. C.

Department of Biological Sciences, University of Abuja, Nigeria.
*Corresponding Author E-mail: johnsol2004@yahoo.com

Received 2 August 2018; Accepted 6 September, 2018

The scarcity of catfish (*Clarias gariepinus*) to stock existing fishpond in Nigeria has been attributed to cannibalism and nutritional problem among other factors. The incessant occurrence of oil spill accidents from the Nigeria oil industries has constantly degraded the aquatic environments where juveniles abound thereby depleting the already poor sources of supply. This study was undertaken to assess the effect of crude oil and some petroleum products on the mortality rate of *C. gariepinus* and also to facilitate inferential deductions that will enhance effective aquatic environmental management. Ninety healthy bred juveniles of catfish (*C. gariepinus*) were randomly placed in 15 plastic baths and were exposed to different concentrations of oil. The results showed that the feeding behavior and swimming performances of fish were reduced after 24 h of the addition of the various oil pollutants. Mortality of juveniles in the oiled basins increased as the hours exposure increased (i.e 24, 48, 72 and 96 h). Crude oil and petroleum fractions cause blockage of atmospheric oxygen from dissolving in water thereby limiting the supply of oxygen to fish juveniles resulting to incidence of excretory waste products (carbon dioxide and ammonia) in the ambient water environment. Recovery was not immediate in the treated basin while surviving juveniles in the control basins grew up to post-juveniles after 90 days. There were significant differences ($P<0.01$ and $P<0.05$) in the effect of crude oil and the petroleum products on the mortality rate of *C. gariepinus* when exposed to oil pollutants at 1.25 ml.

Keywords: Oil, spillage, catfish, water body

INTRODUCTION

Pollution is defined as the addition or presence in the environment of one or more contaminants in such quantities and of such duration which tends to alter the physical, chemical or biological characteristics in a way that it becomes injurious to human health, animal or plant life (Ndubuisi and Asia, 2007). The African catfish *clarias gariepinus* is the most popular and widely cultivated fish in Nigeria (Awa and Alegbeleye, 1991). *Clarias gariepinus* is consumed widely in Nigeria because of its nutritive value. The protein and vitamin content of the catfish has been the object of numerous research reports especially vitamin C (Ascorbic acid). Ascorbic acid is an indispensable and multifunctional micronutrient. It plays important role in improving immune function (Hardie *et al.,* 1991), improving growth and providing good health (Khajarern and Khajarern, 1997).

Pollution from crude and refined oil (petroleum product) is common worldwide and particularly endemic in countries whose major economies are dependent on the industry. In Nigeria, crude oil was first discovered at Olubiri in 1956, and it has generated so much revenue for the country (Akpofure *et al.,* 2000).

The degree of hazardous effect of crude oil product is dependent on their concentration, chemical compound and solubility in water. These products have been recognized as a potential environmental contaminant shortly after the beginning of twentieth century (Albers, 1995). In Nigerian water, cases of oil spillage have been between 1958 to date, releasing about 2.4 million barrel of crude oil into coastal aquatic environment. Oil spills pollute ground water, on which many people depend as a source of drinking water. Spills seep into streams, lakes

and reservoir which are drinking water source as well as habitat of fish, birds and other wildlife (Piatt *et al.*, 1990).
Whenever oil spills, spreading takes place almost immediately. The gaseous and liquid component evaporates, some get dissolve in water while the others may become oxidized or undergo bacteria degradation. The products eventually sink to the bottom and smother benthic plant and animals (Akpofure *et al.,* 2000).

The scarcity of *Clarias gariepinus juveniles* to stock existing fishpond in Nigeria has been attributed to cannibalism and nutritional problem (Faturoti *et al.,* 1986) among other factors. The incessant occurrence of oil spill accidents from the Nigeria oil industries has constantly degraded the aquatic environments where juveniles abound thereby depleting the already poor sources of supply. The aim of this research paper is to assess the effect of crude oil and petroleum product on *Clarias gariepinus (catfish),* to investigate the toxic effect of crude oil and petroleum product level of fraction on *Clarias gariepinus* (catfish), to determine the growth and behavioral responses before and after the application of crude oil and petroleum product on *Clarias gariepinus* (catfish), to determine the feeding and swimming rate of the fish before and after the application of crude oil and petroleum product and to highlight some possible control and management measures of oil spillage in the aquatic water bodies.

MATERIALS AND METHODS

Study area

This research was carried out in the main campus University of Abuja. The University of Abuja main campus is located along Nnamdi Azikiwe Airport road, FCT-Abuja. It has a bearing of latitude 9° 32 North and longitude 50° 10 East with land mass of 11,824 hectares. Abuja has rich soil for cultivation and enjoys an equable climate that is neither too hot (35°C) nor too cold (22°C) all year round (Dankishiya and Chiaha, 2012).

Sample collection

Collection of light crude oil and petroleum products from the Department of Petroleum Resources (DPR), Nigerian National Petroleum Corporation (NNPC), Abuja in air tight plastic can. Purchased of ninety apparently healthy juvenile catfish (*Clarias gariepinus)* from the department of fisheries and aquaculture, agricultural development program (ADP) Gwagwalada, Abuja. The juvenile were in the range of 8-10 cm and mean weight of (27±09) in size. Water temperature was maintained at 27°C during transportation by introducing ice cubes preserved in a portable cooler. The juveniles were starved overnight to eliminate pre-consumed food; after which they were fed aquamas food two times daily at 3% body weight. The fish was acclimatized for the period of two weeks prior to the commencement of the experiment in the Biological Science Laboratory Department, Faculty of Science.

Experimental design

Fifteen plastic basins of twenty litres were placed into five groups according to experimental treatments (Crude oil, petrol, kerosene, Engine oil and control) and replicated three times. Six juvenile (27**±**9 g) was allotted to each of the plastic basin and flooded with fifteen (15) litres of tap water and their mean weight was recorded. Before the commencement of the experiment, the tap water sample was allowed to stand for seven (7) days to reduced concentration of ammonia and chlorine. Water temperature in degree celsius (°C) and hydrogen ion concentration (pH) were also checked and recorded. The amount of carbon dioxide was determined using Lind (1979) method. This experiment which lasted for ninety four days involves three phases and was carried out in the Department of Biological Science, Faculty of Science. The phases are;

(i) Monitoring and recording of the mortality rate of juveniles (*Clarias gariepinus)* under crude oil and petroleum fraction concentrations.
(ii) Observing the feeding behavior and swimming performance of juveniles.
(iii) Checking the survival of juveniles within 90 days after exposure to water-oil mixture for 96 h (4 days).

Physicochemical parameter

Physicochemical parameter was determined; Water temperature in the treatment basins was taken daily with the aid of mercury in tube thermometer, the temperature was taken by immersing the thermometer (mercury in tube thermometer) into the water in an inclined position for about 5 min to allow for equilibrium before it was taken and expressed in Celcius. pH is termed as logarithm of the hydrogen ion concentration. The pH was determined with litmus paper dipped into the water-oil mixture and allowed to stand for 5 min before noting the corresponding colors of the pH indicator. Carbon dioxide (CO_2) was determined using the method described by Lind, (1979); 250 ml of water sample was measured into a 250 ml Erlenmeyer flask, 10 drops of phenolphthalein indicator was added and titrated against sodium hydroxide (NOH) solution until a weak color was attained. The concentration of carbon dioxide (CO_2) was calculated and expressed in mgl thus:
Titre Value (ml) of N140 NAOH × (1 mg).

For the experimental treatment, increases in carbon dioxide (CO_2) concentration were synonymous with increase in dissolved oxygen concentration. This probably explained the reasons for mortality of juveniles recorded during the experiment.

(i) Exposure of juveniles (27±9 g) to different crude oil and petroleum fraction concentrations; The six juveniles allotted per experimental treatment with 1.25 $ml.L^{-1}$ concentration of crude oil, petrol, engine oil, kerosene and the control was maintain on a diet of aquamax food and feed two times daily at 3% body weight. Uneaten food and fish excrement was periodically eliminated with a 5 mm diameter plastic siphon and fresh water replenish to 15 litres mark.
(ii) The *Clarias gariepinus* juveniles in this experiment was monitored for 96 h (4 days) of oil exposure for mortality, feeding behavior and swimming performances. After 96 hours exposure period, surviving juveniles was transferred into fresh basins containing clean borehole water and maintained for 90 days with their experimental feed to assess the success of their survival and degree of recovery from oil exposure.
(iii) Statistical analysis of the experiment was completely randomized and data obtained subjected to analysis of variance (ANOVA) (Steel and Torie, 1980).

RESULTS AND DISCUSSION

The total number of dead juveniles (*Clarias gariepinus*) per day in 1.25 $ml.L^{-1}$ concentration of crude oil, kerosene, Petrol, and engine oil are shown in (Tables 1 and 2). The first record of mortality was obtained at 4:16 pm on the second day of the experiment (24 hours) when one juvenile in R1 engine oil concentration died after struggling and gasping for air. Few minutes after this observation, one juvenile in R1 crude oil concentration stood with its head pointing vertically upward, struggled for air and died (Table 2). In all, mortality of juveniles in the various oiled basins increased as the house of exposure to oil pollutants increased (i.e, from 24, 48, 72, and 96 h). From the mortality records obtained it was evident that the highest number of juveniles died in the crude oil treatment (Table 3) followed by those in kerosene and engine oils respectively. Juveniles in the petrol and the control treatments gave the same results before 96 h (Table 2). After 96 h, juveniles in the petrol oil treatment started dying. As indicated below, all the surviving juveniles after 96 h were transferred into fresh basin with clean tap water and monitored for survival up to 90 days. *Clarias gariepinus* in the petrol oil treatment started dying after 96 h while all the surviving juveniles treated with crude oil and Kerosene oil died within 14 and 21 days of experimental period. Only juveniles in the control survived without any record of mortality and grew up to post-juveniles within 90 days (3 months). Table 4 shows the effect of oil treatment (Crude oil, Petrol oil, Kerosene oil and Engine oil) on the juveniles of *Clarias gariepinus*.

Apart from the control experiment, which recorded no juvenile mortality, the mean mortality within 96 h was highest in crude oil treatment (1.75) and least in petrol oil treatment (0.00). Statistically, the effect of crude oil and some petroleum products on the mortality rate of *Clarias gariepinus* was significant at both 1% and 5% probabilities. Crude oil and petroleum fractions (kerosene, engine oil and petrol) cause the blockage of atmospheric oxygen from dissolving in water thereby limiting the supply of oxygen to fish juveniles resulting to incidence of excretory waste products (carbon dioxide, ammonia) in the ambient water environment. Increases in the free carbon dioxide concentration (Tables 4-5) as the exposure period increases could be synonymous with decreases in dissolved oxygen (D.O) concentration and this probably explained the mortality of *Clarias. Gariepinus* juveniles recorded during the experiment (Tables 3 and 4). From the mean mortality of juveniles (Table 3), the 1.25 $ml.L^{-1}$ crude oil treatment could probably be adjudged as the treatment that obliterated nearly half the population of fingerlings (7) from an original number of eighteen (18) within 96 h (LC50). The percentage mortality derived from this estimation was 38.8% (Table 3). This study agreed with Nwamba *et al.,* (2001) experiment which recorded 56.0% mortality for Heterobranchus bidorsalis juveniles treated with 1.25 $ml.L^{-1}$ crude oil. The mortality experienced in the crude oil and petroleum fractions treatments (1.25 $ml.L^{-1}$) was in consonance with Lee, (1975) view that oil products concentration of 0.01ml.L-1 accelerated the death of juveniles in aquatic environments. Comparing the percentage mortality rates of C*. gariepinus* (Table 2) in the four oil treatments, it was obvious that crude oil adversely affected the survival of juveniles than any of its fractions (petrol, kerosene and engine oil). This observation provided useful insights to the menace of crude oil to aquatic organisms during regular oil spillage in Nigeria. The percentage mortality (38.8%) of *Clarias gariepinus* was, however, less than that recorded by Nwamba *et al*. (2001) (56.0%) when H. bidorsalis juveniles were exposed to crude oil (1.25 $ml.L^{-1}$) for 96 h. This revealed that *Clarias gariepinus* was more resistant and had a higher survival propensity than H bidorsalis when exposed to crude oil pollution. Recovery was not immediate for juveniles in the treated basins while surviving juveniles in the control basin grew up to post-juveniles after 90 days (3 months). This agrees with Kopperdaul, (1976) report that fresh water quality near the spill is suitable for survival and growth of sensitive stages of aquatic organisms.

Table 1. Mean weight of juveniles (*Clarias gariepinus*) in each treatment.

Crude oil (g)	Petrol oil (g)	Kerosene oil (g)	Engine oil (g)	Control
32.63	24.18	19.80	22.73	38.08
18.09	19.75	21.63	19.45	24.32
24.72	33.09	18.05	33.27	18.93
31.64	32.16	27.28	19.24	22.75
28.93	18.96	33.65	20.29	31.06
40.43	40.22	27.28	26.63	27.45
37.08	30.18	32.40	40.27	36.27
19.24	19.16	40.02	32.16	20.08
36.42	27.41	45.60	18.93	29.50
28.36	32.08	27.28	26.13	31.27
22.72	24.37	20.18	19.94	40.32
39.05	18.45	36.18	36.28	19.18
24.96	36.22	37.06	24.75	18.29
43.08	22.31	27.95	20.63	36.27
20.45	43.82	41.27	40.28	37.45
22.36	20.95	18.69	32.16	42.94
20.20	19.63	20.95	29.05	18.26
18.45	36.24	27.90	30.16	29.08
28.26	27.73	27.53	27.3	28.97

Table 2. Number of dead juveniles (*Clarias gariepinus)* per day in 1.25ml.L^{-1} crude oil, kerosene, petrol and engine oil.

Period	Replicates	Crude oil	Petrol oil	Kerosene	Engine oil	Control
24 h	R_I	1.00	0.00	0.00	1.00	0.00
	R_2	0.00	0.00	0.00	0.00	0.00
	R_3	0.00	0.00	0.00	1.00	0.00
	Mean value	0.33	0.00	0.00	1.00	0.00
48 h	R_I	1.00	0.00	1.00	1.00	0.00
	R_2	0.00	0.00	0.00	0.00	0.00
	R_3	0.00	0.00	0.00	1.00	0.00
	Mean value	0.33	0.00	0.33	0.67	0.00
72 h	R_I	1.00	0.00	1.00	1.00	0.00
	R_2	0.00	0.00	0.00	0.00	0.00
	R_3	2.00	0.00	0.00	0.00	0.00
	Mean value	1.00	0.00	0.33	0.33	0.00
96 h	R_I	1.00	0.00	2.00	1.00	0.00
	R_2	0.00	0.00	1.00	0.00	0.00
	R_3	1.00	0.00	0.00	0.00	0.00
	Mean value	0.67	0.00	1.00	0.33	0.00

Table 3. Percentage mortality rate of juveniles *Clarias gariepinus* within 96 h (4 days).

Treatment	No. of juveniles	Mean weight of juveniles (g)	No. of juveniles	Percentage mortality (%)
Crude oil 1.25 ml.L^{-1}	18	28.26	7.00	38.88
Petrol oil 1.25 ml.L^{-1}	18	27.73	0.00	0.00
Kerosene oil 1.25 ml.L^{-1}	18	27.53	5.00	27.78
Engine oil 1.25 ml.L^{-1}	18	27.37	4.00	22.23
Control	18	28.97	0.00	0.00

Control and management measures

Oil spills could be controlled through several measures such as:

(a) Strict supervision of loading and off-loading of oil tankers.
(b) Placing stringent measures on oil and oil related

Table 4. Effect of 1.25 ml.L^{-1} concentrations of crude oil and some petroleum products on *Clarias gariepinus* juveniles.

Treatment	R1	R2	R3	Total mortality	Mean mortality
Crude oil 1.25 ml.L^{-1}	4.00	0.00	3.00	7.00	1.75
Petrol oil 1.25 ml.L^{-1}	0.00	0.00	0.00	0.00	0.00
Kerosene oil 1.25 ml.L^{-1}	3.00	2.00	0.00	5.00	1.25
Engine oil 1.25 ml.L^{-1}	3.00	0.00	1.00	4.00	1.00
Control	0.00	0.00	0.00	0.00	0.00
Grand total	10.00	2.00	4.00	16.00	4.00

F-value = 18.55; ($p>0.01$) and ($p<0.05$).

Table 5. Free Carbondioxide (CO_2) mgl. Records in oiled basins treated with crude oil and petroleum fractions.

Period	Replicates	Control	Crude oil	Kerosene	Engine oil	Petrol oil
24 h	R_l	0.15	0.20	0.20	0.10	0.20
	R_2	0.15	0.15	0.20	0.20	0.10
	R_3	0.15	0.50	0.50	0.10	0.10
	Mean value	0.15	0.28	0.30	0.13	0.13
48 h	R_l	0.10	0.30	0.15	0.15	0.10
	R_2	0.30	0.20	0.15	0.20	0.10
	R_3	0.20	0.30	0.15	0.15	0.10
	Mean value	0.20	0.29	0.15	0.17	0.10
72 h	R_l	0.16	0.30	0.20	0.10	0.20
	R_2	0.16	0.30	0.30	0.20	0.15
	R_3	0.16	0.30	0.20	0.10	0.10
	Mean value	0.16	0.30	0.23	0.13	0.15
96 h	R_l	0.20	0.40	0.30	0.50	0.20
	R_2	0.20	0.40	0.30	0.50	0.20
	R_3	0.20	0.30	0.50	0.50	0.20
	Mean value	0.20	0.37	1.00	0.50	0.20

industries.
(c) Employing scientists and ecologists to assess oil and refinery effluents from oil industries.
(d) Biologists alerting the nation once they observe the presence of oil in water.
(d) Ensuring that adequate safety measures be implemented to prevent accidental oil spillage by both producers and users.
(e) Repairing leaking oil pipe lines and damaged oil tankers and finally,
(f) Oil related industries should have standard laboratories for both water chemistry, pharmacological and toxicological studies.

Conclusion

The responses (survival and mortality) of *Clarias gariepinus* in this study shows the overall impact of Nigerian oil spills on juvenile populations. Hydrocarbons constitute a minor but ubiquitous component of all aquatic organisms. The chemical stability and wide structural differences make these hydrocarbons a good environment; especially when release is increasingly important to differentiate between biogenic and fossil fuel hydrocarbons in order to accurately assess the extent of oil pollution. Knowledge of natural hydrocarbon background in Nigerian aquatic environments is limited and need to be expanded to include indicator species where possible. This studies showed that crude oil and refined oil gain entry into aquatic environment through different sources. Also exposure to oil in water may lead to impairment of fish physiological such as alterations in the gills, brain, liver, spleen, etc; Degenerated muscle folds, separate muscle fibres; reduce growth, etc as well as increase mortality rate. This greatly reduces the world's fishery resources. The proffered control measures if applied would greatly reduce oil pollution and enhance fishery resources.

REFERENCES

Ndubuisi AL, Asia IO (2007). Environmental pollution in oil producing areas of the Niger Delta Basin, Nigeria: Empirical assessment of trends and people's perception. *Environmental research journal* 1(1-4):18-2622.

Awa JN, Alegbeleye WO (1991).Occurrence and treatment of cracked skull disease affecting Clarias species in homestead ponds in Nigeria. *Journal of fish diseases*, 14:431-505.

Hardie LJ, Fletcher TC, Secombes CJ (1991). The effect of dietary vitamin C on the immune response of the Atlantic salmon (Salmosalar L.). *Aquaculture*, 95:201-214.

Khajarern J, Khajarern S (1997). Stability and bioavailability of vitamin C- glucose in *Clarias* hybrid catfish (*Clarias gariepinus* and *Clarias macrocephalus*). *Aquaculture*, 151:219-224.

Akpofure EA, Efere ML, Ayawei (2000). Oil spillage in Nigeria's Niger Delta integrated Grass root post impact assessment of acute damaging effects of continuous oil spillage in the Niger Delta. *A paper report on oil spillage in Niger Delta*. Pp.269-273.

Albers PH (1995). Petroleum and individual polycyclic Aromatic hydrocarbons. In: Handbook of Ecotoxicology. Lewis publishers, Boca Raton. Pp. 330-335.

Piatt JF, Lensick CJ, Butter W, Kendziorek M, Nysewande DR (1990). Immediate impact of the Exxon Veldex oil spill on marine birds. Asek, 107:387-397.

Faturoti EO, Balogun AM, Ugwu LLC (1986). Nutrient utilization and growth responses of *Clarias* (*Clarias Lazera*) fed different dietary protein levels. *Nigerian journal of applied fisheries and hydrobiology*. 1:41-45.

Dankishiya AS, Chiaha NQ (2012). Physicochemical parameters of some selected stations in lower Usuma Reservoir, Bwari, Nigeria. Report and opinion. 4(2):1-6.

Lind OT (1979). Handbook of common method in Limnology. The C.V. Mosby Publisher, Missouri, USA 2nd Edition. Pp.199.

Steel RGD, Torrie JH (1980). Principles and procedures in statistics. McGraw-Hill, New York, USA, Toronto and London, 451pp.30.

Lee RF (1975). Fate of Petroleum hydrocarbons in marine Zooplankton. In:Proc. On prevention and control of oil pollution. *American Petroleum institute, Washington*, D.C. 549-553.

Nwamba HO, Ugwu LLC, Aghamuo HU (2001). Effect of Nigerian Bonny light crude oil on mortality rate of *Heterobranchus bidorsalis* fingerlings. In: Proceedings of 16th annual conference and international workshop of the Nigerian Association of Aquatic Science, 3rd - 6th October, 2001. 46:112-232.

Kopperdaul FR (1976). Guidelines for performing static acute toxicity fish bioassays in municipal and industrial waste waters. California State Water Resources Control board report. p.65.