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Growth Response of Catfish (*Clarias gariepinus*) Exposed to Water Soluble Fraction of Detergent and Diesel Oil

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Abstract: The growth and behavioural survival of catfish (*Clarias gariepius*) was studied. About 10 fishes of average weight 3.5 kg and length 3.05 cm^2 were stocked per aquarium tank containing four WSF of detergent and four WSF diesel oil with replicate. The fishes were fed twice daily at 2.5% of their body weight for 21 days. The weights of the fishes were taken every 7 days. The percentage survival observed in all exposures increased with decreasing concentration. Detergent showed the highest mortality within the first 24 h, other behavioural symptoms include increased operculum beat, erratic swimming, loss of equilibrium and gasping for air. The result showed that sub-lethal concentration effect of the WSF of the detergent and diesel oil reduces the growth of *C. gariepius*. The mean growth of the control fingerlings was 1.80 g while that of WSF of detergent was 1.26 g and WSF diesel oil was 1.35 g in 21 days, respectively. The relative growth rate after 21 days were +6.4% for diesel oil, +5.9% for detergent while that of the control was +8.4% for the mean value. The results showed that a detergent affects the growth and survival of catfish fingerlings than crude oil.

Key words: *Clarias gariepinus*, survival, growth, detergent, diesel oil, water soluble fraction

INTRODUCTION

Every day, large amounts of detergents, cleaning agents and cosmetics are used containing substances that affect the environment, irritate the skin and even cause allergy (Hellmann, 1981). That is why, in recent years, environmental concerns relative to the health and vitality of aquatic ecosystems have become emerging issues in Nigeria. One of the principal reason for this is that many toxic and bioaccumulative chemicals (such as metals, dioxin, mineral hydrocarbons, organochlorine, pesticides, Polycyclic Aromatic Hydrocarbon (PAHs), Polychlorinated Biphenyls (PCBs) have contaminated the freshwater bodies. Hunt described petroleum as consisting of hundreds of compound, ranging from simple methane, molecular 16 up to the very large complex molecules of the asphaltenes. Many of these compounds are stable and highly toxic, some being potent carcinogens and other mutagenic. The main sources of petroleum hydrocarbon pollution are oil spills, oil-tanker washings and ffshore production (Dey *et al*., 1983; Neff, 1990; Steinhauer *et al*., 1994; Syvertsen, 1996) and studies have estimated that the quantity of crude oil and their constituent hydrocarbons which enter the marine environment is in the range of 2-20 million tons per annual. The composition of crude oil and its products is giving rise to a variety of toxicity and contamination problems (Dede and Kaglo, 2001). The levels of these problems are strongly influenced by demographic and socio-economic consideration (Tissot and Welte, 1984). Various changes occur when oil is spilled at sea. These encompass bacterial degradation, photooxidation, evaporation, emulsification, dissolution, dilution by spreading, clustering to form tar-ball and formation of the Water Soluble Fraction (WSF) and Water Accommodation Fraction (WAF) (Dey *et al*., 1983; Neff, 1990; Ehrhardt *et al*., 1992).

Clarias gariepinus is a species of high important in Nigeria freshwater and is widely cultured owing to its high market price, fast growth rate and ability to withstand adverse environmental conditions especially low dissolved oxygen content. Several studies have examined the effect of oils on the developmental stages and the growth of young fish. Rice *et al*. (1975) found that the eggs of pink salmon were the most resistant to crude oil.

The present study on the growth and behavioural responses of catfish fingerlings (*C. gariepinus*) is undertaken to provide a basis for future comparative studies.

MATERIALS AND METHODS

Fish samples: Apparently healthy fishes of catfish fingerlings (*C. gareipinus*) of mean weight 3.50 g were obtained from the Oyo state fisheries department, Agodi, Ibadan and transported in unaerated containers to the

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laboratory. The fishes were acclimatized for at least 12 days. During this period, the water was aerated with air pump (aerator). They were fed with dried commercial fish food containing 40% crude protein at 2.5% of body weight twice daily. Catfish (*C. gariepinus*) was selected because it is an ecologically and economically important group of the tropical inland waters and are very important resources of the aquatic system of tropical Africa.

Preparation of test media: Seventeen glass aquaria tanks were used as test containers. The water soluble fraction of diesel oil was prepared by mixing 1 L of diesel oil obtained from a Gas station and diluting with 4 L of water in accordance with Baden (1982). The mixture was stirred with a Gallenkamp magnetic stirrer for 24 h. It was made to stand for 3 h before it was poured into separating furnnel and allowed to stand for 6 h. The lower layer of water was decanted into the glass aquaria (Afolabi *et al.*, 1985). It was repeated until sufficient quantity of water soluble fraction was obtained. For the detergent, a fraction of (Linear alkylate sulphonate) about 50 g was weighed and mixed with 5 L of water to get the stock solution needed for the bioassay.

Exposure of test organism: The water soluble fraction was made into four concentrations (7, 5, 3 and 1 mL) for the detergent and four concentrations (175, 87.5, 43.95 and 21.87 mL) for diesel oil. The dilution was made with the aerated water. Ten fingerlings were exposed each to four concentrations of the Water Soluble Fraction (WSF) in 20 L capacity plastic containers. Each plastic container was aerated with mechanical pumps. Feeding was discontinued 24 h before the start of the experiment (Reish and Oshida, 1987). The volume of water to the weight of fishes was calculated in accordance with Reish and Oshida (1987) standard of 12 g of fish to 5 L. The catfish fingerlings were observed for 96 h and any behavioural changes and mortality were recorded.

Long-term renewal toxicity test: Renewal toxicity test was conducted for a period of 21 days to study the effect of sub-lethal concentration of water soluble fraction of detergent and diesel oil on the growth and survival of the fingerlings. At the end of the 96 h exposure period, the catfish fingerlings were removed and placed in clean water (containing no toxicant) for the rest of the 17 days. The fishes were fed twice daily and the weights were taken every 7 days till end of the exposure period. The growth parameter which was obtained to determined the significance of the water soluble fraction of detergent and diesel oil on the growth of the test organism was calculated using the formula:

$$RGR\,(\%) = \frac{W_f - W_i}{Time} \times 100$$

$$K = \frac{100 \times W}{L^3}$$

Where:

RGR = Relative Growth Rate
K = Constant
W = Total body weight of the fish in g
L = Standard length of fish in centimeters
W_f = Final weight
W_i = Initial weight
T = Time

Physico-chemical parameters: Records of temperature, pH and dissolved oxygen were taken before and during the exposure period. The pH was measured with pH tester 10 m, temperature was measured using a mercury in glass thermometer. The dissolved oxygen was measured by Winkler's titrimetric method as described by Taylor *et al.* (1998).

RESULTS AND DISCUSSION

The results of the WSF of detergent and diesel oil on *Clarias gariepinus* within 96 h is shown in Table 1. The median lethal concentration LC_{50} values were estimated by arithmetic graphic methods, respectively as obtained by earlier workers. Table 2-3 shows the effect of the water soluble fraction of detergent and diesel oil on the growth of *C. gariepinus*.

The mean growth increase in weight for detergent in replicate A was 1.13 g at 0.053 g growth rate per day and replicate B was 1.26 g at 0.059 g growth rate per day. The mean growth increase in weight for water soluble fraction of diesel oil in replicate A was 1.08 g at 0.051 g growth rate per day and replicate B was 1.35 g at 0.064 g growth per day while that of control was 1.82 g at 0.08 g growth per day. The exposure of *C. gariepinus* to water soluble

Table 1: Mortality of fingerlings of *C. gariepinus* of detergent and diesel oil (Toxicity testing at 96 h)

	Time (h)						
Items	1	12	24	36	48	72	96
Hourly LC_{50} for detergent	-	0.024	0.021	0.021	0.025	0.016	0.016
Hourly LC_{50} for diesel oil				22.000	20.000	17.500	15.000

Table 2: Effect of water soluble fraction of detergent on the growth of *C. gariepinus* fingerlings

Replicate	Container (mL)	Initial weight (g)	Final weight (g)	Growth increase in weight (g)	Growth rate (g day^{-1})	Relative growth rate	Percentage growth (%)
A	7	10.94	11.87	0.93	0.044	4.4	8.50
	5	11.75	12.84	1.09	0.051	5.1	9.27
	3	9.74	10.84	1.10	0.052	5.2	11.29
	1	11.64	13.04	1.40	0.066	6.6	12.02
Mean		11.01	12.14	1.13	0.053	5.3	10.26
B	7	13.70	14.81	1.11	0.052	5.2	8.10
	5	11.94	13.10	1.16	0.055	5.5	9.71
	3	10.36	11.74	1.38	0.065	6.5	13.32
	1	10.60	11.99	1.39	0.066	6.6	13.11
Mean		11.65	12.91	1.26	0.059	5.9	10.81

Table 3: Effect of sub-lethal concentration of water soluble fraction of diesel oil on the growth of *C. gariepinus* fingerlings

Replicate	Container (m L^{-1})	Initial weight (g)	Final weight (g)	Growth increase in weight (g)	Growth rate (g day^{-1})	Relative growth rate	Percentage growth (%)
A	175.00	13.40	14.40	1.00	0.047	4.7	7.46
	87.50	15.29	16.34	1.05	0.050	5.0	6.86
	43.95	12.00	13.10	1.10	0.052	5.2	9.16
	21.87	10.20	11.40	1.20	0.057	5.7	11.76
Mean		12.72	13.81	1.08	0.051	5.1	8.54
B	175.00	15.54	16.66	1.12	0.053	5.3	7.20
	87.50	13.54	14.96	1.42	0.067	6.7	10.48
	43.95	16.93	18.34	1.41	0.067	6.7	8.32
	21.87	10.44	11.90	1.46	0.069	6.9	13.98
Mean		14.11	15.46	1.35	0.064	6.4	9.56

Table 4: The growth analysis of the study

No.	Initial weight (g)	Final weight (g)	Growth increase in weight (g)	Growth rate (g day^{-1})	Relative growth rate	Percentage growth (%)
1	2.84	4.09	2.00	0.09	9.0	70.40
2	2.86	4.46	1.60	0.07	7.6	55.94
3	1.57	3.57	2.00	0.09	9.0	70.40
4	1.59	3.84	2.25	0.10	10.7	141.50
5	2.29	3.56	1.27	0.06	6.0	55.45
Mean	2.23	3.90	1.82	0.08	8.4	81.60

Table 5: Physico-chemical parameters

Variables	Temperature (°C)	pH (°C)	Dissolved oxygen (mg L^{-1})
Diesel oil	25.92±0.16^{a}	7.05±0.11^{a}	6.17±0.07^{a}
	26.13±0.06^{b}	7.97±0.03^{b}	5.63±0.18^{b}
Detergent	26.31±0.44^{a}	7.66±0.49^{b}	6.28±0.23^{a}
	25.78±0.21^{b}	8.01±0.08^{b}	6.98±0.11^{b}
FEPA	20-33	6.0-9.000	6.0-8.000

*The statistical analysis shows that the mean values with the same alphabets are not significantly different form each other

fraction of detergent showed mortality even at low concentration and exhibited a wide range of behavioural responses. These include pronounced gasping for breath erractic swimming behavior, uncoordinated movement and occasional darting up and down the water column. This can be attributed to nervous reaction of the organism to the irritating effects of the detergent and diesel oil (toxicant) and disturbance in physiological mechanism, which according to Alkahem (1994) initiate maintain and terminate such behaviour. The growth performance of the fingerlings exposed to sub-lethal concentration of detergent and diesel oil were significantly different ($p<0.05$). Moles and Rice (1983) noted that the exposure of pink salmon to sub-lethal concentration of water soluble fraction of crude oil for 40 days resulted in significantly smaller fishes compared to the control. The most likely explanation for the growth reduction in this study is increase in metabolism due to detoxificzation and impaired health. The active feeding became more vigorous during the renewal period. This coupled with the insignificant reduction suggest that reduced growth cannot be explained entirely by lack of food. It would be unlikely that the growth reduction found in this study were due to energy loss alone (Table 4). The Temperature reading fell between 25-27°C which were within the limit for tropics fishes. Baden (1982) showed that toxicity increased with temperature thus the overall toxicity recorded for detergent and diesel oil was not influenced by temperature which was within the normal range. Dissolved oxygen content was maintained at 5.63-6.98 mg L^{-1} using air pumps.

Engelhardt *et al*. (1981) observed that the toxicity of several poisons (to rainbow trout) increased in direct proportion to the decreased in oxygen content of water. The oxygen stress encountered by the fish that is responsible for the respiratory distress and death was due to their inability to withstand the oxygen depletion of the water induced by the active organic compound in the water soluble fraction of the diesel oil and detergent. Similar oxygen stress imparted by the water soluble fraction of crude oil had been studies in the Shrimp, *Palaemon adspersus* (Baden, 1982) (Table 5).

CONCLUSION

It is apparent that the exposure of *C. gariepinus* to water soluble fraction of Detergent and diesel oil induced various behavioural responses dependent on the concentration of the toxicant and period of exposure. This study established that growth performance of *C. gariepinus* is invariably affected by the water soluble fraction of diesel oil and detergent. More research still need to be done to ascertain further effects of detergent and diesel oil on the gonad, skin and kidney. Moreover, assessment should be made to determine the toxicity of the active ingredient of detergent for safer use.

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