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Toxicity of Nigerian Crude Oil and Chemical Dispersants to *Barbus* Sp. and *Clarias* Sp.

Alade Akintonwa and Anyachukwu G. Ebere

Toxicology Research Laboratory, Department of Pharmacology, College of Medicine, University of Lagos, P.M.B. 12003, Lagos, Nigeria

During an oil-spill, several contingency arrangements are made to limit environmental damages by the spilled oil. An acceptable method is the use of chemical dispersants which break up the oil slick into oil in water emulsions. These chemicals are widely used in our riverine areas during routine cleaning of oil spillage with little regards to their ecological impact on the environment.

Swisher et al.(1964), Schmid and Mann (1962), have demonstrated that chemical dispersants caused damage to the respiratory epithelium of the fish gills. Perkins (1970) showed that surfactants impaired several biologic functions in marine gastropods. Anionic surfactants were shown to be more toxic to fishes and decapods than the non-ionic (Swedmark et al. 1979). Recent study showed that chemical dispersants such as Conco-k, Foremost and BP 1100X were highly toxic to Mullet mugil and Clibinarious africanus (Oyewo, 1986). In order to assess the impact of oil spillage and several chemicals used in the cleaning operation, it was thought necessary to study the toxicity of crude oil and chemical dispersant alone and when both are used in combinations. The dispersants used in this study are concentrates and hence in use situations, 2-15% dilution is made and then sprayed. This generally depends on the size of the spill, as a 10:1 (crude oil:dispersant) ratio is recommended. At this dilution the dispersants adequately break up the crude oil. The present study also reports the potentiation of toxicity of crude oil by two chemical dispersants (Teepol and Conco-k) on Barbus sp fingerlings and Clarias eggs.

MATERIALS AND METHODS

The crude oil (Asabo 16c) and the chemical dispersants (Teepol and Conco-k) were obtained from Mobil oil Producing Ltd., Lagos, Nigeria. The test organism, Barbus sp and Clarias brooders were obtained from local fish ponds. All the tests were conducted in an air conditioned room with an average temperature of 24±2°C.

Several concentrations of the crude oil (20-80 ml in 4 litres) were added to the dilution water. Each concentration was in 4 litres of

Send reprint requests to Alade Akintonwa at the above address.

water to give the appropriate concentrations in the test chamber. The solutions were mixed thoroughly and followed by gently swirling intermitently with a glass rod to form a homogenous layer (in the case of crude oil). This simulated the conditions of low turbulence normally encountered in Delta areas of oil drilling and spillage in Nigeria. Adequate aeration was maintained using a thermostatically controlled Air-Compressor, Model DEN 135 (BLITZ). The organisms were allowed five days for acclimatization before the commencement of the experiment.

In another set of experiments, various concentrations of crude oil plus dispersants were tested ($10x10^3$ uL/L crude oil +5 uL/L Teepol; $10x10^3$ uL/L crude oil + 5 uL/L conco-k and 5 uL/L Teepol +5 uL/L conco-k). These combinations used are however two thousand times less than the recommended ratio of 10:1 (crude oil: dispersant). For each concentration tested twenty organisms were used. All the tests were started by introducing twenty test organisms from the holding tanks into the test chamber within an hour of preparation of the mixtures. A fish was presumed dead when there was neither bodily nor opercular movement even after gentle prodding. The number of dead fish was recorded every 24 hour until 96 hours when the experiment was terminated. The LC50 was estimated by graphical interpolation and the approximate nomographic method of Litchfield and Wilcoxon (1949).

Two brooders, male and female weighing 2-4 kg. were obtained from local sources. The two brooders were injected with dried carp pituitary hormone. The female was administered twice the dose of the male - Heteroplastic hypophyseation. They were left in a big swimming tank over-night. In the morning laid eggs which had been fertilized were scooped with a hand net and transfered into cleaned disinfected chambers for incubation.

Several concentrations of crude oil (1, 2.5, 5 x 10^3 uL/L). Conco-k (1,2.5, 5uL/L), Teepol (1, $2.5x10^3$ uL/L) were made in different test tanks and the eggs added to these tanks. The chamber which served as control had no chemicals added to it. All the chambers were observed for the next 24 hours.

RESULTS AND DISCUSSION

Table 1 overleaf shows the toxicity of crude oil, and chemical dispersants to Barbus fingerlings. The calculated crude oil LC50 was 21.5, 16.5 and $8.6x10^3$ uL/L at 24, 48 and 96 hour test period respectively. Conco-k had an LC50 of 11.5, 7.6, 5.7 at 24, 48 and 96 hour. Teepol is the most toxic of all the three tested chemicals with an LC50 of 7.8, 6.0 and 5.9, for the test periods.

Table 2 shows the effect of Chemical dispersants on crude oil toxicity. Crude oil (10 uL/L), Teepol 5 uL/L and Conco-k 5uL/L produce 20, 20 and 10 percent lethality respectively in the test organism. Teepol at 5uL/L increased the crude oil induced lethality from 20 to 70.0%. Conco-k at 5uL/L increased the crude oil lethality from 20 to 90 percent in the test organism. Teepol 5 uL/L potentiated the effect of conco-k from 10 to 100 percent lethality.

Table 1 Calculated LC50s of Crude Oil, And Chemical Dispersants On Barbus Sp Fingerlings.

Chemical Agent	Calculated LC50 (uL/L)	Slope Function	Confidence Limit
	24 Hour		
Crude Oil	21.5×10^3	2.89	$14.23-32.5 \times 10^3$
Conco-k	11	2.0	8.0-17.6
Teepol	7.8	1.93	6.04-10.01
	48 Hour		
Crude Oil	16.5×10^3	7.8	$7.5-36.76 \times 10^3$
Conco-k	7.55	2.1	6.0-10.34
Teepol	6.0	1.49	5.04-7.14
	96 Hour		
Crude Oil	8.6×10^3	4.13	$5.05-14.9 \times 10^3$
Conco-k	5.7	2.2	4.38-7.61
Teepol	5.9	1.73	4.76-7.3

Table 2. Potentiation of Crude Oil Toxicity by Chemical Dispersants

Group	Treatment	Percent Lethality
I	Crude Oil 10 uL/L	20.0
II	Teepol 5 uL/L	20.0
III	Conco-k 5 uL/L	10.0
IV	Crude Oil 10 uL/L + Teepol 5 uL/L	70.0
V	Crude Oil 10 uL/L + Conco-k 5 uL/L	90.0
VI	Conco-k uL/L + Teepol 5 uL/L	100.0

Table 3. Effect of Crude Oil and Chemical Dispersants on the Hatching of Clarias Eggs

Group	Treatment	Percent Lethality
I	Clarias eggs + fresh water	10%
II	Clarias eggs + Crude Oil 5 uL/L	80%
III	Clarias eggs + Teepol 5 uL/L	100%
IV	Clarias eggs + Conco-k 5 uL/L	100%

Table 3 shows the effect of crude oil and chemical dispersant on the hatching of clarias eggs. In the untreated groups 90% of the fertilised eggs hatched within 24 hour and these hatchlings were maintained for at least 5 days. In the groups II, III and IV that were treated with crude oil, Teepol and Conco-k (5 uL/L) less than 10 percent of the clarias eggs hatched within 24 hours.

Oil spillage is a major form of industrial pollution associated with exploration and transportation of petroleum in the Delta Region of Nigeria. The pollution often leads to loss of farm crops and aquatic life. It is estimated that over 1,678,990 barrels of crude oil have been spilled into our environment within the last 10 year period.

The present study showed that Nigerian crude oil is toxic. The The LC50 of ASABO crude oil is 21.5×10^3 uL/L at 24 hour. In the 96 hour study, the LC50 decreased from 21.5 to 8.6×10^3 uL/L - meaning an increased toxicity of the crude. It is believed that this is due to bioaccumulation of the hydrocarbon. Blummer et al (1970) also reported that when Oyster - Cassostera Virginica are exposed to oil they non-selectively accumulate the crude oil in their tissues.

The oil dispersants, teepol and Conco-k which are commonly used to clean up the environment during oil spillage were found to be much more toxic to Barbus fingerlings than the crude oil itself. Oyewo (1986) has shown that three of the commonly used oil dispersants in Nigeria are highly toxic to Clibinarious africanus and Mullet mugil Sp. However, no information was provided on the effect of combination of crude oil with oil dispersant. Our study clearly shows that when these dispersants were used in combination with crude the toxicity of the oil increases. The result clearly shows that a combination of crude oil and oil dispersant are much more toxic than each chemical alone. Therefore the use of oil dispersant in eventof oil spill calls for caution and proper evaluation of the impact on the ecological fauna of the environment. Portman and Connor (1968) found solvent emulsifiers to be more toxic to marine crustaceans, mollusks and fishes than crude oil.

Loaning and Hangstrom (1970) also showed that the combination of corexit 9527 and crude oil resulted in deleterious effects on fertilization and embryotoxic development in several species of marine organisms. The present study also shows that both the crude oil and chemical dispersant have deleterious effects on the hatchability of clarias eggs and on the development of the embryo. Clarias is a very important economic fish in our coastal environment. Crude oil and oil dispersant inhibited hatching of the Clarias eggs and are toxic to the larvae at the stage before the completion of yolk absorption. Although sublethal concentrations of crude oil and dispersants were used, they still affected the growth

at this early stage. Jeanatte et al. (1970) also observed delayed developmental rate of embryo, irregular heart beat rate, abnormal larvae at hatching and consequent death of hatchling when the organnisms were exposed to 35-45 ppm benzene. Considering the importance of a safe environment, it is necessary that the application of any chemicals in the aquatic environment should take into cognisance the safety of the plants and animals therein. Efforts should be made to develop chemical dispersants that are very less toxic to aquatic life.

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