Scientia Africana, Vol. 23 (No. 5), December, 2024. Pp 97-106
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TOXICITY OF GOLD CREW AND SDS DISPERSANTS ON *TILAPIA GUINEENSIS*

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Received: 22-07-2024
Accepted: 18-11-2024

https://dx.doi.org/10.4314/sa.v23i5.8

Journal Homepage: http://www.scientia-african.uniportjournal.info
Publisher: *Faculty of Science, University of Port Harcourt.*

ABSTRACT

Oil spill impacted waterbodies are cleaned up using dispersants like Gold Crew® (GC) and sodium diodecyl sulphate (SDS). Since dispersants are chemicals, the potentials for negative impact on the applied environmental compartment cannot be ruled out. This study was a bioassay aimed at investigating the toxicity of Gold Crew and SDS dispersants on Tilapia guineensis. The weight of test organism (T. guineensis) was 222.5±2.11 mg while mean total and standard lengths were 2.20±0.47 and 1.75±0.03 cm respectively. Mean values for physiochemical parameters of habitat water were pH 7.25±0.06, conductivity 13.20± 0.85 µS/cm, alkalinity 18.04±1.12 mg/L, hardness 58.71± 3.24 mg $CaCO_3$/L, salinity 0.59±0.02 ppt and dissolved oxygen 3.96 ± 1.17 mg/L. All test organisms were first acclimated for 10 days at room temperature (28 ±2 °C). Range finding test was carried out to establish a preliminary working range by obtaining the least concentration that gives no effect and the minimum concentration that gives 100% death. Acute toxicity tests were carried out by exposing the organisms to test solutions containing various concentrations of the dispersants using the semi–static agitation test procedure. The number of test organism decreased with respect to time even at a particular concentration and also decreased as concentration increased. A comparative assessment of the two dispersants showed that Gold Crew was more toxic to the test organism Tilapia guineensis than SDS at the same concentration. A slight concentration of 0.05 ml/L of Gold Crew gave 90 % mortality after 48 h exposure while 100 mg/L SDS gave 100 % mortality at the same duration. Also at 0.05 ml/L Gold Crew and 100 mg/L SDS for exposure period of 72 and 96 h, both dispersants gave 100 % mortality. Gold Crew should be treated as a more toxic dispersant compared to SDS at various concentrations and exposure times and extreme care is needed if it is used during clean-up of oil impacted waterbodies. From the probit analysis of the toxicity results, the lethal concentrations at which 50% of test organism died (LC_{50}) for SDS at various time is given as LC_{50} (24 h) 54.99 mg/L, LC_{50} (48, 72 and 96 h) 22.29 mg/L while those of Gold Crew were LC_{50} (24 h) 0.064, LC_{50} (48 h) 0.048, LC_{50} (72 h) 0.029 and LC_{50} (96 h) 0.025

Keywords: Oil spill, waterbodies, *Tilapia guineensis*, gold crew, SDS

INTRODUCTION

Crude oil spill in the Niger-Delta area of Nigeria emanating from oil and gas industry operations has resulted in serious environmental degradation and human, material and economic losses to governments at all levels, communities and oil companies

(Aroh *et al*., 2010; Osuji *et al*., 2010; Nnaji *et al*., 2018). The remediation or clean-up of oil spill environment is important for the survival of both terrestrial and aquatic organisms. This can be done using chemical dispersants which are mixtures of surfactants (surface active compounds), stabilizers and one or more solvents (Faurot-Daniels, 2016). Surfactants contain hydrophilic and hydrophobic components, they act by reducing surface tension at the oil-water interface thereby breaking up the oil slick into tiny droplets that are more easily dispersed into the water column by physical turbulence (Little, 2000). This increases the surface area of oil which is then degraded by natural biodegradation, evaporation and photo-oxidation.

Gold Crew® oil spill dispersant (OSD) is composed of water and proprietary Blend of ethoxylated octylphenolic surfactants (ECS, 2018). It is a water-based concentrate designed to emulsify oil products in water and when it is sprayed on an oil or fuel spill, it solubilizes oil into very minute particles (nanoparticles) and then encapsulates and surrounds these particles of oil. This encapsulation prevents the oil or fuel from forming a slick (rainbowing effect) and the particles of oil are suspended in the body of the OSD water-based solution. These nanoparticles of oil become food source for naturally occurring bacteria. This means that Gold Crew® enhances the biodegradation process and the oil is quickly and naturally removed from the environment. Gold Crew is non-toxic at low concentration and works with both fresh and salt water. It does not produce toxic fumes and is not irritating to the skin. It is diluted one part product to twenty parts water and up to 60 parts depending on the type of hydrocarbon to be dispersed. 100 drums of Gold Crew concentrate makes at least 200 drums of usable dispersant (US EPA, 2001; US EPA, 1999). SDS is a linear molecule with an alkyl tail of 12 carbon atoms, attached to a sulphate group giving the molecule the amphiphilic properties of a surfactant (Karsa, 1992). SDS is represented by the molecular formula $C_{12}H_{25}N_aO_4S$ or $CH_3=(CH_2)_{11}\text{-}O\text{-}SO_3\text{-}Na^+$ with molecular weight of 288.38g/mol. Occurrence of SDS in the environment arises mainly from its presence in complex domestic and industrial effluents as well as its release directly from some applications (oil dispersants and pesticides). It has been reported that SDS is toxic and affects survival of aquatic animals such as fishes, microbes like yeast and bacteria. It is also toxic to mammals like mice and humans but to lesser extent (Fendinger *et al*., 1994). Several studies have indicated the potential hazards on aquatic organisms from the use of chemical dispersants though it is generally agreed that dispersants used currently are much less toxic compared to earlier ones (Ostroumov, 2006; Lustgarten, 2010; Hamdan and Fulmer, 2011; Milinkovitch *et al*., 2011; USEPA, 2015; Graham *et al*. 2016). Literature exists on the toxicity of several chemicals including dispersants on *Tilapia guineensis* (Ezemonye *et al*., 2007; Ogeleka *et al*., 2016; Omogoriola and Ayoola, 2018) but none was found on the toxicity of Gold Crew on the species. This study was undertaken to assess and compare the toxicities of Gold Crew® and SDS dispersants on *Tilapia guineensis* which will provide baseline information and enable public health authorities to properly regulate the use of chemical dispersants for crude oil removal in waterbodies. *Tilapia guineensis* was selected for the study due to its wide availability, sensitivity and relative ease of handling.

MATERIALS AND METHODS

Experimental Location

The experiment was carried out at the Environmental Microbiology Laboratory, Department of Microbiology, University of Port Harcourt, Rivers State, Nigeria. The test dispersants Gold Crew® OSD and SDS were obtained from dealers in Port Harcourt who supply them to the Oil companies.

Scientia Africana, Vol. 23 (No. 5), December, 2024. Pp 97-106
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Sampling and Specification of Test Animals

Fingerlings of *Tilapia guineenis* were collected from African Regional Aquaculture Centre (ARAC) at Aluu near University of Port Harcourt, Rivers State, Nigeria. They were caught with cast nets and were transferred immediately into 25 litre open plastic containers containing the habitat water. A total of 600 fish were caught and were used for the experiment. The weights and lengths of the test animals were determined with analytical balance and metre rule respectively. It was ensured that there was not more than a two-fold difference between the minimum and maximum sizes (as body length) of the specimen used.

Acclimatization and Selection of Test Organisms

All test organisms were first acclimatized for ten (10) days at room temperature (28 ± 2 °C) in properly aerated glass aquaria. They were also fed with fish feed obtained from ARAC at 5 % body weight. The water in the acclimatization unit was replaced with fresh water from the organism's habitat daily. There was controlled lighting system (12 h of light and12 h of darkness). Ten (10) test organisms of fairly equal size were randomly caught with hand nets from acclimatization tanks and carefully transferred into the test vessel. The organisms were not touched with hand during the selection so as to avoid stress due to handling. Only healthy and active test organisms were selected.

Semi-static Renewal Bioassay

Acute toxicity tests were carried out by exposing the test organisms (*Tilapia guineensis*) to test solutions containing various concentrations of the test sample using the semi – static agitation test procedure as recommended by DPR (2002). Range finding test was carried out to establish a preliminary working range by obtaining the least concentration that gives no effect and the minimum concentration that gives 100% death. Test design incorporated multiple widely spaced concentrations with single replicates. Exposure times were 4 h, 8 h, 24 h and 48 h. Five different concentrations of the test toxicants (20, 40, 60, 80, 100 mg/L for SDS and 0.01, 0.02, 0.03, 0.04, 0.05 ml/L for Gold crew®) were prepared in triplicate using habitat water of the organism as diluent and stirred for 5 min and subsequently stirred at intervals of 5 min. Ten (10) healthy, active test organisms were carefully introduced into bioassay vessels (glass aquarium of 50 cm x 30 cm) at different toxicant concentrations. Controls containing dilution (habitat) water and 10 test organisms were prepared without the toxicants. Each of the test concentrations were labelled appropriately. After each day, the media were replaced with fresh one at the same toxicant concentration and this was done each day for four days. Dead organisms were also removed at the end of each exposure period in order to avoid contamination of live organisms by bacteria from dead decaying organisms. Mortality was recorded after 4, 8, 24, 48, 72 and 96 h exposure period (Ogbonna *et al*., 2009).

Physicochemical Analysis of Water

The pH of the habitat water was measured electrometrically by inserting the electrode of a pre-calibrated Mettler Toledo pH metre (model AG 8603) into the sample and taking the reading when the metre stabilized. The conductivities of the water samples were determined with a Jenway Conductivity metre (model 4510 brand) which was calibrated with 0.1 M potassium chloride (KCl) solution. Salinity was determined titrimetrically by the measurement of 25 ml of sample into a 100 ml conical flask, addition of 2 drops of K_2CrO_4 and titrating with 0.025 M $AgNO_3$ to a red colour end point. Total alkalinity was determined by the titration of water samples to which methyl orange indicator and sodium thiosulphate had been added with 0.02 M standard HCl solution to a faint orange colour (methyl orange end-point). Water hardness was determined by titration of 25 ml of water sample to which buffer solution and Eriochrome black-T indicator had been added with standard EDTA titrant slowly with

constant stirring until a blue colour appeared (APHA, 2012). Total dissolve solid (TDS) was measured using Jenway TDS probe metre (model 4510 brand) that was calibrated with KCl solution. Temperature was measured electrometrically with the probe of the Mettler Toledo pH meter. Dissolved oxygen (DO) was determined by inserting the probe of an Extech DO meter (model SDL 150) into the habitat water and taking the reading after the probe stabilized.

Data Analysis

The percentage mortality of the test organisms was calculated by dividing the number of dead organisms by the total number of the test organisms and multiplying by 100%. The mortalities recorded at 24, 48, 72 and 96 h were tabulated and LC_{50} (median lethal concentration) for these times and confidence intervals also calculated based upon the Probit method of analysis. Percentage mortality was converted to Probit using Finney (1971) Probit method. The concentration of the test chemical was converted to log_{10} and the probit points were regressed to evaluate for the LC_{50} for the study. The negative log of the value of the concentration at y = 5.0 was evaluated. Where calculated LC_{50} were three or more values, they were plotted unto a dose relationship graph. The slope and 95 % confidence interval of slope were determined. LC_{50} is a typical dose response curve which is based on the principles of statistical probabilities of an event occurring within described concentrations and exposure. In this regard, its calculations and interpretations are valid as the limits of its statistical confidence limits.

RESULTS AND DISCUSSION

Average Weight and Length of Test Organism

The average weight of *Tilapia guineensis* used was 222.5 ± 2.11 mg. This is bigger than size (191 ± 5 mg) of *Tilapia guineensis* used by Ogbonna *et a*l. (2009) in a study on dose-time effect of crude oil and hydro-test effluent on freshwater and brackish water habitats. The mean total length of *Tilapia guineensis* used was 2.20 ± 0.47 cm which was smaller than the length (2.50 ± 0.5 cm) of *Tilapia guineensis* used by Ogbonna *et al*. (2009). Mean standard length of the test organisms was 1.75 ±0.03 cm.

Physicochemical characteristics of fresh water

Table 1 shows the result of physicochemical analysis of habitat water. This implies that the composition of this water can support aquatic life.

Table 1. Some physicochemical characteristics of habitat water

Parameter	Test vessels	Control vessels
pH	7.25 ± 0.06	6.82 ± 0.13
Temperature (^oC)	26.50 ± 0.20	28.32 ± 0.52
Conductivity (µS/cm)	13.20 ± 0.85	17.83 ± 1.64
Alkalinity (mg/l)	18.04 ± 1.12	23.91 ± 3.47
Hardness (mg/l)	58.71 ± 3.24	45.60 ± 2.95
Total dissolved solid (mg/l)	7.67 ± 0.15	5.33 ± 0.49
Salinity (ppt)	0.59 ± 0.02	0.63 ± 0.18
Dissolved oxygen (DO)	3.96 ± 1.17	4.27 ± 1.25

The findings of Ogonna *et al*., (2009) on physicochemical parameters of habitat water was in agreement with our result especially for temperature, alkalinity, salinity, TDS and DO. The differences in value for other parameters were not statistically significant (P>0.05). While other parameters were within recommended limits, DO was lower than the desired range of 5-15 mg/L recommended for warm water fish (Boyd, 1998; Swann, 2007).

Scientia Africana, Vol. 23 (No. 5), December, 2024. Pp 97-106
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However, there were significant differences between Test and Control vessels physicochemical parameters with respect to conductivity, alkalinity, hardness and TDS.

Result of Range Finding Test for the Dispersants

The range finding test for SDS is presented in Table 2. This was carried out to establish a preliminary working range by obtaining the least concentration that gives no effect and the minimum concentration that gives 100 % mortality after an exposure period of 48 h. The least concentration that gave no effect for SDS was 10 mg/L while minimum concentration that gave 100 % death was 100 mg/L. This range (10mg/L – 100mg/L) was used for the toxicity test. This is in agreement with recommendation of Oyemo (1986) who worked on three oil dispersants and concluded that for a dispersant to be effective in dispersing spilled oil without harm to the aquatic life, range finding test must be done.

Table 2. Range finding test of SDS in fresh water using *Tilapia guineensis*

Conc. mg/L	Time (h)														
	0			4			8			24			48		
	No. of individual	% Survival	% Mortality	No. Surviving	% Survival	% Mortality	No. Surviving	% Survival	% Mortality	No. Surviving	% Survival	% Mortality	No. Surviving	% Survival	% Mortality
0.01	10	100	0	10	100	0	10	100	0	10	100	0	10	100	0
0.10	10	100	0	10	100	0	10	100	0	9	90	10	9	90	10
1.00	10	100	0	10	100	0	10	100	0	9	90	10	9	90	10
10.0	10	100	0	10	100	0	10	100	0	8	80	20	8	80	20
100	10	100	0	10	100	0	0	0	100	0	0	100	0	0	100
1000	10	0	100	0	0	100	0	0	100	0	0	100	0	0	100

The range finding test for Gold Crew is presented in Table 3. The least concentration that gave no effect was 0.01 ml/L while minimum concentration that gave 100 % death was 0.06 ml/L.

Table 3. Range finding test of Gold Crew OSD in fresh water using *Tilapia guineensis*

Conc mg/L	Time (h)														
	0			4			8			24			48		
	No. of individual	% Survival	% Mortality	No. Surviving	% Survival	% Mortality	No. Surviving	% Survival	% Mortality	No. Surviving	% Survival	% Mortality	No. Surviving	% Survival	% Mortality
0.01	10	100	0	10	100	0	10	100	0	10	100	0	10	100	0
0.02	10	100	0	10	100	0	10	100	0	9	90	10	9	90	10
0.03	10	100	0	10	100	0	10	100	0	9	90	10	9	90	10
0.04	10	100	0	10	100	0	10	100	0	9	90	10	9	90	10
0.05	10	100	0	10	100	0	10	100	0	9	90	10	9	90	10
0.06	10	100	0	10	100	0	10	100	0	9	90	10	9	90	10

Acute Toxicities of the Dispersants

Dispersant acute toxicity is generally measured using a multi-concentration or definitive test, consisting of a control which water from the medium and a minimum of five dispersant concentrations. The tests are

designed to provide dose-response information, expressed as the percent dispersant concentration that is lethal to 50% of the test organisms (LC_{50}) within the prescribed period of time (24 - 96 h), or the highest dispersant concentration in which survival is not significantly different from the control. The frequency with which acute toxicity tests are conducted is determined on the basis of factors such as the variability and degree of toxicity of the waste, production schedules, and process changes. Table 4 shows the number of surviving test organisms, % survival and % mortality of *Tilapia guineensis* at various concentrations of SDS at 4, 8, 24, 48, 72 and 96 h duration. It shows that % survival decreased as time progressed while % mortality increased as time progressed. As concentration increased from 20 mg/L to 100 mg/L, % survival decreased as concentration increased whereas % mortality increased as concentration increased. This could be attributed to the effect of SDS on the test organism since the control did not follow this trend. This showed that the longer the time of exposure, the more the effect of SDS on *Tilapia guineensis* and the higher the concentration, the more the effect of SDS on *Tilapia guineensis*. It was observed after 4 h that the percentage survival was 100 % at SDS concentrations 20, 40, 60 and 80 mg/L. At 100mg/l concentration, the percentage survival was 0% while percentage mortality was 100 %. There was much variation at 8 h for percentage survival and percentage mortality. Percentage survival was 100 % at 20 mg/l and 40 mg/L concentration but 50 % and 40 % respectively for 60 and 80 mg/L concentrations. However, % mortality was 0% for 20 mg/l and 40 mg/L but 50 %, 60 % and 100 % respectively for 60, 80, 100 mg/L concentrations. Furthermore, at 24 h only 20 mg/L concentration had 100 % survival while 60 %, 40 % and 20 % survival values were recorded at 40, 60 and 80 mg/L concentrations respectively. The percentage mortalities increased from 10 % at 20 mg/L to 100 % at 40, 60, 80, 100 mg/L from 48 h to 96.

Table 5 shows the number of surviving test organisms, % survival and % mortality of *Tilapia guineensis* at various concentrations of Gold Crew at 4, 8, 24, 48, 72 and 96 h duration. It also shows that % survival decreased as time progressed while % mortality increased as time progressed. The effect of concentrations were obvious; as concentration increased from 0.01 ml/L to 0.05 ml/L % survival decreased whereas % mortality increased. This could be attributed to the effect of Gold Crew on the test organism *Tilapia guineesis* since the control did not follow this trend. This indicated that the longer the exposure time, the more the effect of gold crew on *Tilapia guineensis*. It was also observed that after 4 and 8 h, the percentage survival was 100 % while percentage mortality was 0 % at all concentrations. There was much variation after 24 h for percentage survival and percentage mortality. The percentage survival was 100 % for 0.01, 0.02 and 0.03 ml/L concentrations, but 80 % and 20 % for 0.04 and 0.05 ml/L concentrations respectively with corresponding % mortality of 0 % for 0.01, 0.02 and 0.03 ml/L, 20 % for 0.04 ml/L and 80 % for 0.05 ml/L.

However, at 48 h exposure 0.01 and 0.02 ml/L concentrations showed 100 % survival but 50 %, 30 % and 10 % survival at 0.03, 0.04 and 0.05 ml/L concentrations respectively. The percentage mortality at 0.01 and 0.02 ml/L concentrations was 0 % but 50 %, 70 % and 90% at 0.03, 0.04 and 0.05 ml/L concentrations respectively. Percentage mortality increased from 0% at 0.01 and 0.02 ml/L to 50 %, 70 %, and 100 % for 0.03, 0.04 and 0.05 ml/L respectively after 72 h exposure, but percentage survival varied in the opposite direction. It was observed that after 96 h exposure that the percentage mortality also increased from 0 % at 0.01 and 0.02 ml/L to 60 % and 100 % at 0.03, 0.04 and 0.05 ml/L respectively. The percentage survival also varied in the opposite direction.

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Table 4. Acute Toxicity of SDS

Conc. mg/L	Time (h)																				
	0			4			8			24			48			72			96		
	No. of ind	% Survival	% Mortal.	No. Surviv	% Survival	% Mortal.	No. Surviv	% Survival	% Mortal.	No. Surv.iv	% Survival	% Mortal.	No. Surviv	% Survival	% Mortal.	No. Surviv	% Survival	% Mortal.	No. Surviv	% Survival	% Mortal.
20	10	100	0	10	100	0	10	100	0	10	100	0	9	90	10	9	90	10	9	90	10
40	10	100	0	10	100	0	10	100	0	6	60	40	0	0	100	0	0	100	0	0	100
60	10	100	0	10	100	0	5	50	50	4	40	60	0	0	100	0	0	100	0	0	100
80	10	100	0	10	100	0	4	40	60	2	20	80	0	0	100	0	0	100	0	0	100
100	10	100	0	0	0	100	0	0	100	0	0	100	0	0	100	0	0	100	0	0	100

Table 5. Acute Toxicity of Gold Crew

Conc. mg/L	Time (h)																				
	0			4			8			24			48			72			96		
	No. of ind	% Survival	% Mortal.	No. Surviv	% Survival	% Mortal.	No. Surviv	% Survival	% Mortal.	No. Surviv	% Survival	% Mortal.	No. Surviv	% Survival	% Mortal.	No. Surviv	% Survival	% Mortal.	No. Surviv	% Survival	% Mortal.
0.01	10	100	0	10	100	0	10	100	0	10	100	0	10	100	0	10	100	0	10	100	0
0.02	10	100	0	10	100	0	10	100	0	10	100	0	10	100	0	9	90	10	8	80	20
0.03	10	100	0	10	1001	0	10	100	0	10	100	0	5	50	50	5	50	50	4	40	60
0.04	10	100	0	10	100	0	10	100	0	8	80	20	3	30	70	1	10	90	0	0	100
0.05	10	100	0	10	100	0	10	100	0	2	20	80	1	10	90	0	0	100	0	0	100

The control test organism *Tilapia guineensis* result shows it had 100 % survival throughout the period of the test (0 – 96 h). The result is agreement the work of Dede and Dogara, (2004) who also worked with *Tilapia guineensis* and recorded no death in the control throughout the duration of the experiment.

Probit mortality

Table 6 shows the probit mortality of *Tilapia guineensis* to SDS. The probit values increased as concentration increased with respect to time.

Table 6. Probit mortality of SDS on *Tilapia guineensis*.

Conc. (mg/L)	**Time(h)**						
	0	**4**	**8**	**24**	**48**	**72**	**96**
20	**0.0**	**0.0**	**0.0**	**0.0**	**3.72**	**3.72**	**3.72**
40	0.0	0.0	0.0	4.75	8.09	8.09	8.09
60	0.0	0.0	5.00	5.25	8.09	8.09	8.09
80	0.0	0.0	5.25	5.84	8.09	8.09	8.09
100	0.0	8.09	8.09	8.09	8.09	8.09	8.09

Table 7 shows the probit mortality of *Tilapia guineensis* to Gold Crew. The probit values increased as concentration increased with respect to time.

Table 7. Probit mortality of Gold Crew on *Tilapia guineenis*.

Conc. (ml/L)	Time (h)						
	0	**4**	**8**	**24**	**48**	**72**	**96**
0.01	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**3.72**	**4.16**
0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.03	0.0	0.0	0.0	0.0	5.00	5.00	5.25
0.04	0.0	0.0	0.0	4.16	5.52	6.28	8.09
0.05	0.0	0.0	0.0	5.84	6.28	8.09	8.09

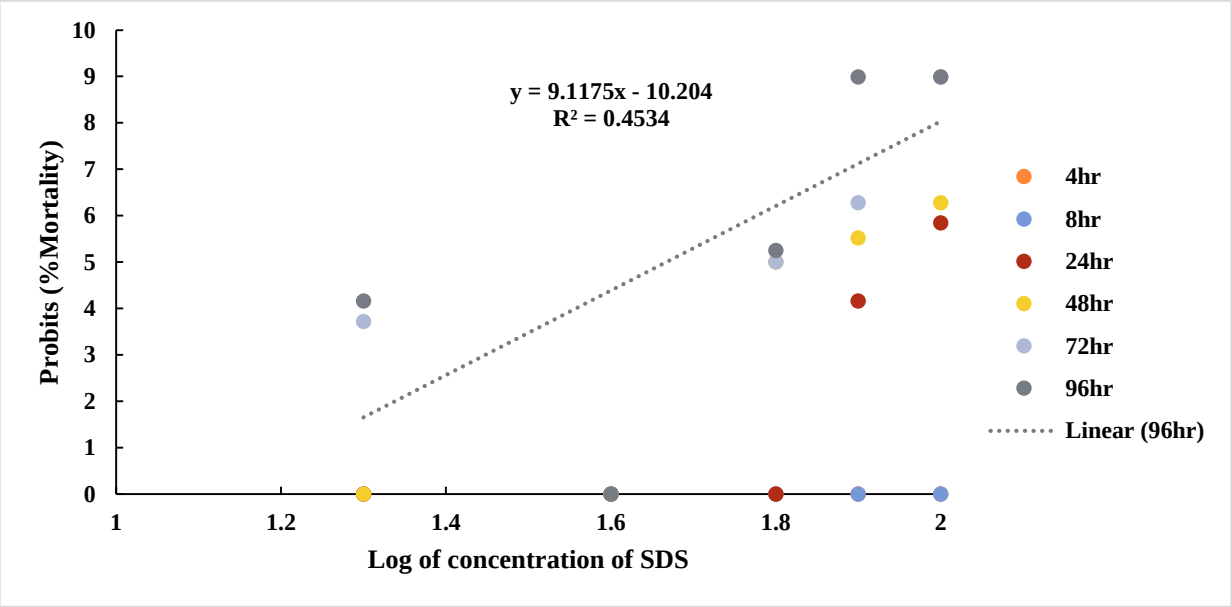

Fig. 4.5: Probit Mortality graph for LC_{50} Calculation for SDS

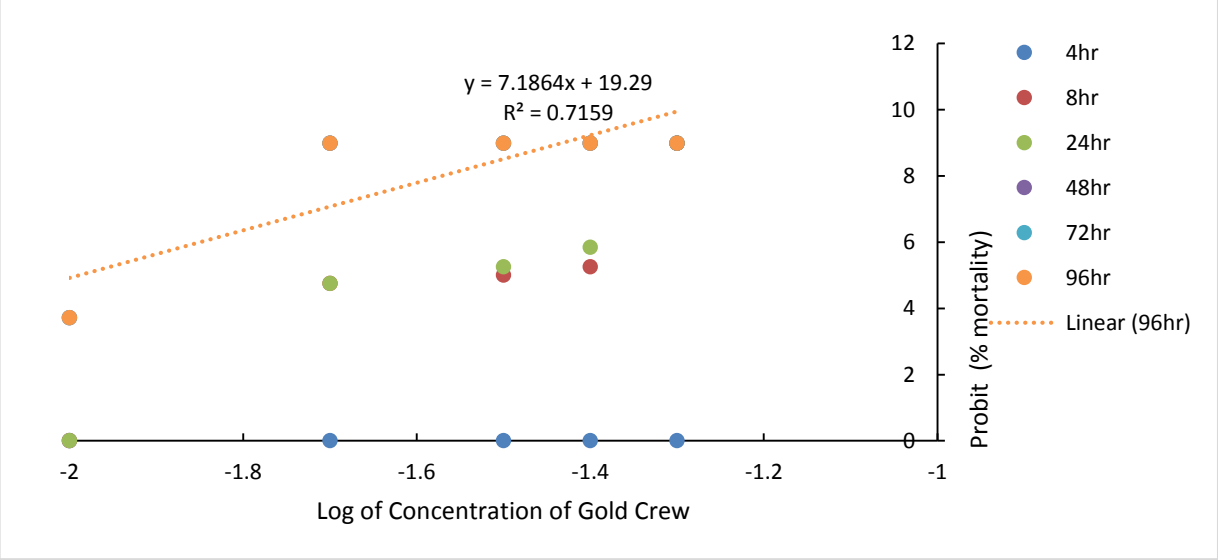

Fig.4.6: Probit graph for LC_{50} Calculation for Gold Crew

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Lethal concentration

The lethal concentrations (LC_{50}) of toxicants on *Tilapia guineensis* is presented in Table 8.

Table 8. Lethal concentrations (LC_{50}) of toxicants on *Tilapia guineensis*

Toxicant	24 h	48 h	72 h	96 h
LC_{50} (mg/l) for SDS	54.99	22.29	22.29	22.29
LC_{50} (ml/l) for Gold Crew	0.064	0.048	0.029	0.025

The LC_{50} of both dispersants, SDS and Gold Crew decreased with respect to time from 54.99 mg/L after 24 h to 22.29 mg/L at 96 h for SDS and 0.064 ml/L after 24 h to 0.025 ml/L at 96 h for GC. From the probit analysis of the toxicity results of SDS, the lethal concentration at which 50% of test organism died (LC_{50}) at various time is given as LC_{50} (24 h) 54.99 mg/L, LC_{50} (48, 72 and 96 h) 22.29 mg/L. The result is close to the findings of Ndimele *et al*. (2010) who obtained 96 h LC_{50} values of 25.12 mg/l for *T. guineensis* fingerlings treated with SDS. Rosety *et al*. (2001) exposed juvenile turbots (*Scopthamus maximus* L) to various concentrations of SDS and discovered 50 % mortality at 384, 190, 12 and 4 h. They also exposed gilthead (*Sparus aurata*) to various concentration of SDS and discovered induced morphological changes in the spleen and kidney with a significant inhibitory effect on fertilization success. Also from the probit analysis of the toxicity result of Gold Crew, the lethal concentration at various times is given as LC_{50} (24 h) 0.064, LC_{50} (48 h) 0.048, LC_{50} (72 h) 0.029 and LC_{50} (96 h) 0.025.

A comparative assessment of the two dispersants showed that Gold Crew was more toxic to the test organism *Tilapia guineensis* than SDS at the same concentration. This is because a slight concentration of 0.05 ml/L of Gold Crew gave 90 % mortality after 48 h exposure while 100 mg/L SDS gave 100 % mortality at the same duration. Also at 0.05 ml/L Gold Crew and 100 mg/L SDS for exposure period of 72 and 96 h, GC and SDS gave same 100 % mortality. Hence gold Crew should be treated as a more toxic dispersant compared to SDS at various concentrations and exposure times. This is in agreement with the report of Vincent (2008, 2015), who consider comparing the toxicity of two different pesticides to aphids, pesticide A and pesticide B. The LC_{50} of pesticide A was 50 µg/L and the LC_{50} of pesticide B was 10 µg/L. Pesticide B was adjudged more toxic than A because it only takes 10 µg/L to kill 50 % of the aphids while 50 µg/L of pesticide A kills the same 50 % of the Aphids.

CONCLUSION

A comparative assessment of the two dispersants SDS and Gold Crew showed that Gold Crew was more toxic to the test organism *Tilapia guineensis* than SDS even at similar concentrations. A slight concentration of 0.05 ml/L Gold Crew gave 90 % mortality after 48 h exposure while 100 mg/L SDS gave 100 % mortality at the same duration. Also at 0.05 ml/L Gold Crew and 100 mg/L SDS for exposure periods of 72 and 96 h, gave the same 100 % mortality. Hence Gold Crew should be regarded as being more toxic compared to SDS at various concentrations and exposure times. Despite the indubitable usefulness of oil dispersants, the potential toxicological effects of dispersants on living beings especially fish must be taken into consideration, and the choice of less toxic molecules must be carefully considered.

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