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ORIGINAL RESEARCH

Effects of detergent containing linear alkyl benzene sulphonate on behavioural response of *Heterobranchus bidorsalis*, *Clarias gariepinus* and *Heteroclarias*

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ABSTRACT
This study investigated the effect of detergent containing linear alkyl benzene sulphonate on behavioural response of *Heterobranchus bidorsalis*, *Clarias gariepinus* and *Heteroclarias.* Fish samples were purchased from private fish farm in Delta state. The fish were allowed to acclimatize for 3 days in the laboratory. Based on the result of range finding test, main experimental set-up was carried out at 0, 50, 100, 150, 200 and 250ppm of the toxicant in a renewed bioassay. Results showed increased body pigmentation, surfacing and air gulping and intermittent swarming, jerky movement increases as the concentration of the toxicant increases, and decline in opercula movement decreases as the concentration of the detergents increases. This suggests toxicological stress on the test organisms. As such, caution should be exercised in the use of detergents in aquatic ecosystems.

KEY WORDS: *Aquatic ecosystem, Behavioural response Detergent, Fishes, Toxicity*

INTRODUCTION

Typically, water is one of the major requirements for the sustenance of life including humans (Izah *et al*., 2016; Izah and Ineyougha, 2015; Izah and Srivastav, 2015; Agedah *et al*., 2015; Ogamba *et al*., 2015a-c; Spirita *et al*., 2015; Seiyaboh *et al*., 2016a,b, 2017). According to Spirita *et al*. (2015), water has a unique place, and as such it is vital for sustaining all forms of life, food production, and economic development. Water resources are classified based on the source including groundwater, surface water and rainwater (Izah and Srivastav, 2015; Izah *et al*., 2016). Among the surface water are three major types including fresh water, estuarine/brackish and marine water (water containing high salt concentration). Surface water is frequently contaminated by the activities of humans or anthropogenic activities (Izah and Angaye, 2016a). Surface water is the major receipt of several waste streams resulting from human activities. For instance, in some coastal region of the world especially in the Niger Delta region of Nigeria municipal wastes are discharged into the water without treatment including sewage (Izah and Angaye, 2016a,b; Agedah *et al*., 2015). Surface water is also a recipient of wastes resulting from industrial and agricultural field which enter the nearby water bodies via runoff after heavy precipitation. Among the various freshwater pollutants, detergents have attracted special attention (Jawahar *et al*., 2015).

Since water is an indispensable resource, it is used for variety of purposes including drinking, bathing, washing

among others. In attempt to keep the environment and household materials clean to avoid outbreak of diseases and allergies, surfactant based soap are used (Lawal *et al*., 2013). Detergents are mostly used for washing and cleaning surfaces. In some rural coastal communities, surface water abound, clothes, plates/dishes are washed in the surface water. In addition, detergents are used to wash equipment, installations, heavy duty machines, vehicles and oil soiled materials in industrial settings (Ogundiran *et al*., 2010). Also in some areas, 'after wash' of the detergents are drained into aquatic ecosystem including ponds, creek, lakes, creeklets, rivers and streams (Spirita *et al*., 2015; Jawahar *et al*., 2015). Also, indiscriminate use, careless handling, accidental spillage of detergent or its untreated effluents could end up in the aquatic ecosystem (Ndome *et al*., 2013). Due to large scale application of detergents in washing powders, dye fasteners, formulation of shampoos, industrial and household cleansing agents, toothpaste, tooth powder and dispersing oil spills, it's a source of contamination to the aquatic ecosystem (Spirita *et al*., 2015; Topale *et al*., 2013)

Among the various surfactants, linear alkyl benzene sulphonate is one of the most extensively used anionic surfactant used for domestic purposes in homes. This could be due to its ability to lower the surface tension of water, enabling soils and stains to loosen and release from fabrics and surfaces (Spirita *et al*., 2015). Again, linear alkyl benzene sulphonate make up about 25% of the total formulation of a detergent as such its referred to as the "engine" of the detergent system (Spirita *et al*., 2015).

Several fish indices have been widely used to assess the toxicological impact of chemical toxicants on fish life. Some of the commonly studied indices include mortality, behavioral response, condition factor, organosomatic, haematological, electrolytes, metabolites, enzymatic and biochemical parameters (Inyang et al., 2016a-f, 2017a-d). Among the various parameters mortality and behavioural response are major indices that do not require much examination especially in juvenile. When fish is stressed by chemical toxicants, notable indications that are frequently observed in their behavior includes changes in their swimming and movement patter, body colouration etc. Over a period of time, mortality could be observed. Therefore, this study aimed at assessing the effect of detergent containing linear alkyl benzene sulphonate on behavioural response of some commonly cultured fish species in the Niger Delta.

RESULTS AND DISCUSSION

Table 1, 2 and 3 present the behavioral characteristics of *Heterobranchus bidorsalis, Claria gariepinus* and hybrid fish respectively exposed to detergent containing linear alkyl benzene sulphonate for between 0 to 72 hours. All the three fish species showed normal swimming characteristics at 0.00ppm concentration, while they deviated from normal as the concentration of the detergent increases. The intensity of body pigmentation, surfacing and air gulping and swarming, jerky movement increased as the concentration of the toxicant increased. While the opercula movement decreased as the concentration of the detergents increased. The observed variation in the behavioral characteristics of the different fish species under study as the concentration of the detergent increases suggests the adverse effect of the detergent on the fishes. This is line with the work of Ndome *et al*. (2013), who reported that variation in behavior of fish exposed to detergent (omo and ariel brands) at lower concentrations may be due to the avoidance behaviour of the test organism to the test substance. Chandanshive (2013, 2014) reported that *Mystus montanus* exposed to household detergent Surf excel and Nirma brands exhibited a variety of behavioural responses including opercular movement which was 20-25 times more faster than controlled, loss of nervous control, try to jump out of media, restlessness, rapid swimming on the lateral side, respiratory distress, frequent surfacing and body pigmentation. Ogundiran *et al*. (2010), Ndome *et al*. (2013) reported behavioral response including respiratory disturbance, erratic swimming, loss of equilibrium, lethargies and sudden fish death in Juvenile African mud fish (*Clarias gariepinus*) exposed to detergent effluents containing Linear Alkylbenzene Sulfonates.

Najam and Bhowate (2010) reported change in behavior pattern viz: surfacing, gulping, mucus secretion from skin, omitting and increase in the rate of gill opercular movement, loss of body balance and change in body colour Poecilia reticulate (Peters) exposed to shampoo. Okwuosa and Omoregie (1995) reported erratic swimming, respiratory distress, loss of balance and increased opercular ventilation

Table 1: Behavioral characteristics of *Heterobranchus bidorsalis* exposed to detergent containing Linear Alkyl benzene sulphonate

Characteristics	linear alkyl benzene sulphonate, ppm					
	0	50	100	150	200	250
Swimming	++	++	+	+	+	-
Colour (body pigmentation)	-	+	++	++	+++	+++
Intermittent swarming	-	+	+	+	++	++
Jerky movement	-	+	+	+	++	++
Opercular movement	++	+	+	+	-	-
Surfacing and air gulping	+	+	++	++	+++	+++

= Absent; + Low; ++ = Moderate; +++=High characteristics

Table 2: Behavioral characteristics of *Clarias gariepinus* exposed to detergent containing Linear Alkyl benzene sulphonate

Characteristics	linear alkyl benzene sulphonate, ppm					
	0	50	100	150	200	250
Swimming	++	++	+	+	+	-
Colour (body pigmentation)	-	+	++	+++	+++	+++
Intermittent swarming	-	+	+	+	++	++
Jerky movement	-	+	+	++	++	++
Opercular movement	++	+	+	+	-	-
Surfacing and air gulping	+	+	++	+++	+++	+++

= Absent; + Low; ++ = Moderate; +++=High characteristics

in *Aphyosemion gairdneri* exposed to alkylbenezene sulphonate.

The findings of this study have some similarity with the findings of other authors on pesticides. Nwani *et al*. (2013) reported uncoordinated behavioral changes (viz: erratic and jerky swimming, increased surfacing and air gulping, decline in opercula movement and secretion of mucus on the body and gills) when *Tilapia zilli* is exposed to Glyphosate, N-(phosphoromethyl) glycine. Inyang *et al*. (2017d) reported increased colour pigmentation, intermittent swarming, surfacing and air gulping and decline in swimming and opercular movement as the concentration detergent increases in *Heterobranchus bidorsalis* exposed to Rhonasate 360SL for 14 days. Ogamba *et al*. (2014) reported behavioural changes viz: restlessness, un-coordinated movement and postural orientation, intermittently swarming in the flank, sudden quick movements, settling at the bottom and excessive mucus secretion on the skin in *Clarias gariepinus* exposed to dichlorvos. Ladipo (2011) reported erratic swimming

Table 3: Behavioral characteristics of hybrid fish exposed to detergent containing Linear Alkyl benzene sulphonate

Characteristics	Linear alkyl benzene sulphonate, ppm					
	0	50	100	150	200	250
Swimming	++	++	+	-	-	-
Colour (body pigmentation)	-	+	+++	+++	+++	+++
Intermittent swarming	-	+	+	++	++	+++
Jerky movement	-	+	+++	++	++	++
Opercular movement	++	+	+	+	-	-
Surfacing and air gulping	+	++	+++	+++	+++	+++

= Absent; + Low; ++ = Moderate; +++=High characteristics

swimming behavior, sudden quick movements, restlessness and weakness at high concentration of paraquat dichloride that Juvenile *Clarias gariepinus* were exposed. Ayoola (2008) reported respiratory stress, erratic swimming and instant death on *Oreochromis niloticus* exposed to glysophate.

Due to alteration in behavioral characteristics, its often seen as one of the most sensitive indicator in toxicological studies (Nwani *et al*., 2010; Inyang *et al*., 2017d). Furthermore, Spirita *et al*. (2015) reported that the stressful and erratic behaviour of the fish exposed to Linear Alkylbenzene Sulfonates provide information about possible respiratory impairment.

CONCLUSION

Fisheries have been widely used to assess the toxicological impact of anthropogenic activities in aquatic ecosystem. This is probably due to bioaccumulation and sensitivity/ response of fisheries to toxicant. Variation in water quality could also affect the diversity, abundance and composition of aquatic organisms. This study evaluated the effects of detergent containing linear alkyl benzene sulphonate on behavioural response of juvenile *Heterobranchus bidorsalis, Clarias gariepinus* and hybrid fish i.e. *Heteroclarias*. The results showed that varying concentration of detergent containing liner alkyl benzene sulphonate causes behavioural response and the intensity of body pigmentation, surfacing and air gulping and swarming, jerky movement increases as the concentration of the toxicant increases. While the opercula movement decreases as the concentration of the detergents increases. Over a prolong period it could lead to mortality. As such caution should be exercised during the use of detergent close to aquatic ecosystem.

MATERIALS AND METHODS

Source of Fish, Transportation and Acclimation

One hundred and eighty (180) healthy juvenile *Heterobranchus bidorsalis, Clarias gariepinus* with mean length 10.00 and 9cm respectively were purchased from private fish farm in Ozoro, Delta state. Furthermore, 180 healthy juvenile hybrid (*Heteroclarias*) with mean length of 3.0cm were obtained from private fish farm in Ughelli, Delta state. The fish samples were transported in 20 liter rubber cans with their natural water and cans covered with fishing net to the laboratory at Niger Delta University were they were allowed to acclimatized in in circular rubber aquaria for 3 days. A renewal bioassay was carried out were test water, and sub-lethal concentrations of toxicant was renewed daily. Fishes were also fed with their normal coupen fish diet (fish meal) at 5% body weight daily at 11:00 hours. Fishes adapted to laboratory conditions with < 1% death recorded. This process was discontinued 24hours before the commencement of the range finding trial.

Range Finding Test (Trial Test)

A static renewal bioassay procedure was employed in this experiment. During the process, the test toxicant (detergent containing linear alkyl benzene sulphonate) and test solution (water) were renewed daily including their feed which was served at an interval of 12 hours. During this process, the fishes were removed and replaced in the test solutions in the original containers. A range finding test (trial test) was carried out using the toxicant in the following concentration (1000ppm, 800ppm, 600ppm and 400ppm) for 2 days, to determine a safe sub-lethal concentration for the main experimental run.

Main Experiment

Based on the findings of range finding test, the main experiment was carried out using the same procedure as the trial test and lowering the concentration of the toxicant for a period of 3 days at 12 hour interval. The following concentration of the toxicants were made 0, 50, 100, 150, 200 and 250ppm. There were three (3) treatment levels with ten (10) fishes. Each treatment contains different trade mark of detergent containing linear alkyl benzene sulphonate. Borehole water was used as diluents and control. The experiment lasted for 3 days or 72 hours.

Behavioral response

The behavioral changes checked for by observing the reaction of the fishes as the toxicant at different concentration are introduced into the aquarium for about 2 hours daily (Inyang *et al*., 2017d). The characteristics previously used to assess behavioural response on fisheries exposed to pesticides by Inyang *et al*. (2017d), Nwani *et al*. (2013, 2010), Ladipo (2011), Ayoola (2008) was employed in this study.

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