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Research Paper

The implications of linear alkyl benzene sulphonate on selected enzymes in the muscle and plasma of two life stages of *Clarias gariepinus*

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ABSTRACT

Recently, changes in enzymes concentrations are being employed in the evaluation of toxicological responses for rapid detection or to predict early warning of xenobiotic toxicity. Examinations on the chronic effects of a locally produced detergent on selected biomarker enzymes in the muscle and plasma of *Clarias gariepinus* juveniles and adults were carried out. Adults (mean weight, 850.00 ± 10.22 g SD; mean length 29.20 ± 7.12 cm SD) and Juveniles (mean weight, 246.30 ± 14.12 g SD; mean length 16.15 ± 1.40 cm SD) and of *C. gariepinus* were obtained from a Fish Farm in Port Harcourt, Rivers State, and transported in four of 50 L plastic containers to the laboratorory of the Department of Fisheries and Aquatic Environment, Rivers State University, Port Harcourt. Fish specimens were acclimated in rectangular plastic aquaria with 20 L of water each for seven (7) days. Detergent definitive tests of 10.00, 20.00, 30.00, 40.00 and 50.00 mg/L were obtained through a serial dilution process. Acid phosphatase (ACP), Alkaline phosphatase (ALP), Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) activities in the muscles and plasma of fish juvenile and adults were all altered due to the impact of detergent on the organs in the two life stages (juvenile and adult). Anthropogenic substances should be properly treated before introduction into any aquatic environment with organisms of economic importance.

Key words: Acid phosphatase (ACP), Alkaline phosphatase (ALP), Alanine aminotransferase (ALT), Aspartate aminotransferase (AST), plasma, muscle.

Abbreviations: ACP: Acid phosphatase; **ALP:** Alkaline phosphatase; **ALT:** Alanine aminotransferase; **AST:** Aspartate aminotransferase.

INTRODUCTION

Domestic waste containing detergents and sewage effluents was a neglected group of pollutants as it was thought to be mild in adverse effects. Nigeria has a rich tradition of the use of natural products especially in the field of body adornment. This includes natural cleansing agents, herbal shampoos, pollen based powders, and perfumes, etc. Cleanliness and sense of beauty have received priority since the evolution of *Homo sapiens,* next to the basic needs of food, shelter and clothing. The traditional materials used for such purposes in earlier days paved way in course of time to many synthetic formulations (Nath et al., 2008; Walpita et al., 2007).

Until 1918, soap (sodium/potassium salt of long chain fatty acids) was the main product used for cleaning. With the introduction of chemical industries, the production and use of detergents and cosmetics developed and the demand for these products automatically increased with better standards of living. Moreover, there has been an increased use of these synthetic detergents since 1960. The detergents have an edge over soap as they are unaffected by the hardness of water and are superior to soaps in their efficacy. The manufacturing of detergents in Nigeria is at

present carried out by several units scattered in organized and small-scale sectors. There is no law so far pertaining to Nigerian Standard Specifications for the quality and quantity of the ingredients to be used in detergents and cosmetics. Testing and analytical facilities for detergents are few and there is lack of stringent regulation or legislation (Fafoye et al., 2004; Omoniyi et al., 2002). However, in spite of all these, the demand and the use of detergents have attained new dimensions in the fields of laundry industry, in pesticide formulations, pharmaceuticals, plastics, herbicides and many other products of day to day use.

Detergents are complex mixtures of surface-active compounds or surfactants (10 to 18%), builders and bleaches. Surfactants are mixtures of homologues of a material differing in chain length and degree of substitution etc. Usually, the properties of these compounds are additives, that is, the total property is the sum of the properties of individual constituents. After use these are discharged as domestic waste and reach the environment through sewers and/or sewage treatment plants.

Surfactant is an amphipathic molecule and may be anionic, cationic or non-ionic based on the characteristic ionizable group present in it. The builder component used in earlier days was sodium tripolyphosphate (STPP). These phosphate containing detergents were found to cause 40% accumulation of phosphate in rivers in the early sixties which led to eutrophication and subsequent nitrogen imbalances (Viran et al., 2003).

Detergents were also found to have adverse effects on humans. They affect the skin by removing the stratum conium and react with other skin proteins. They also aid in the penetration of other substances as well. Skin irritation due to detergents is not a problem where machine washing is the rule, but in Nigeria where washing is done largely by hand it is of great significance. Skin irritation potential of several anionics like sodium dodecyl sulfate and non-ionics were investigated and these were found to cause allergic dermatitis (Carrey and Almoth, 2008). Approximately, 15 million tons of soap and synthetic surfactants are being used worldwide (Wells et al., 1986).

Surfactants most commonly used in commercial detergents were linear alkyl benzene sulfonate (LAS), alkyl ethoxylates (AE), alkyl phenol ethoxylates (APE) and quaternary ammonium compounds (QAC). Alkyl benzene sulfonate (ABS) was the commercially important laundry surfactant in earlier days, but was banned as it was non-biodegradable and was also highly toxic to aquatic life. It was substituted by the linear alkyl benzene sulfonate (LAS) as an anionic compound. LAS, a petroleum product is treated with oleum or sulphur trioxide gas to obtain it. It is then neutralized with alkali with the addition of other ingredients like fillers (Singh and Banerjee, 2008).

LAS was the most extensively studied surfactant and several references regarding quantification and toxicity of the chemical to a large number of invertebrates and vertebrates are made available (Svoboda, 2001). This study is to further reveal the impact of this detergent on the enzymes' status of some important organs of *C. gariepinus,* a fish of very high economic importance in Nigeria. African mudfish (*C. gariepinus*) is a bottom dweller. They are also obligate air breathers, and do spend some time at the surface, which enable them to survive in very poorly oxygenated waters (Pienaar, 1991). They are also able to secrete mucus in extreme drought conditions to prevent drying out and can burrow in the muddy substrate of a drying water body to survive (Pienaar, 1991; Skelton, 2001). This fish can adapt to extreme environmental conditions and can live in a pH range of 5.6 to 8. They are also able to live in very turbid waters and can tolerate temperatures of 8 to 35°C (Paul, 2007).

C. gariepinus possess an elongated body with fairly long dorsal and anal fins. The dorsal fin has 61 to 80 soft rays, while the anal fin has 45 to 65 soft rays. They have strong pectoral fins with spines that are serrated on the peripheral areas (Teugels, 1986). This species can attain sizes up to 1.7 m (total length) and can weigh up to 59 kg when fully mature. They possess nasal and maxillary barbels and relatively small eyes (Teugels, 1986; Skelton, 2001). Their skin is smooth exhibiting a dark grey colour dorsally and a cream to white colour ventrally. Scales are absent. Adults possess a dark longitudinal line on either side of the head, however, this is absent in the younger fishes. The head is large, depressed, heavily boned and coarsely granulated in adults, while in the young fish the head is smooth. The mouth is quite large and sub-terminal (Skelton, 2001).

This species is referred to as the 'sharptooth catfish' due to the presence of fine, pointed bands of teeth (Skelton, 2001). They are not specific in their food requirements. They are known to feed on insects, plankton, snails, shrimps and other invertebrates and are also capable of eating dead mammals, birds, reptiles, amphibians, small mammals, fish, eggs and arid plant matter such as fruits and seeds. They are poor swimmers and spend most of the time on the bottom of lakes and rivers (Pienaar, 1991). They are, however, able to move across land to other water sources during damp conditions (Skelton, 2001). This is achieved by simply extending their strong pectoral fins and spines allowing them to crawl through shallow pathways. They are mobile on land and hence are able to sometimes prey on terrestrial organisms. *C. gariepinus* has been known, during intra-specific aggressive interactions to emit an electric organ discharge that is head-positive, lasting 5 to 260 ms (Skelton, 2001; Teugels, 1986).

MATERIALS AND METHODS

Adults (mean weight, 850.00± 10.22 g SD; mean length 29.20 ± 7.12 cm SD) and Juveniles (mean weight, 246.30 ± 14.12 g SD; mean length 16.15 ± 1.40 cm SD) and of *C. gariepinus* were obtained from a Fish Farm in Port

Table 1: Activities of selected enzymes in the muscle of *C. gariepinus* Juveniles exposed to Jumbo detergent for 30 days (Mean ± S.D).

Conc. (mg/L)	AST (IU/L)	% Control	ALT (IU/L)	% Control	ACP (IU/L)	% Control	ALP (IU/L)	% Control
0.00	98.75±39.45^{a}	100	20.00±1.21^{a}	100	15.00±5.77^{c}	100	60.00±11.55^{c}	100
10.00	251.67±14.43^{c}	+ 154.90	26.67.±11.55^{ab}	+33.35	10.00±1.21^{a}	- 33.33	53.33±5.77^{ab}	-11.12
20.00	423.33±37.53^{d}	+328.69	26.67.±11.55^{ab}	+33.35	13.33±5.77^{ab}	-11.13	31.67±6.64^{a}	-47.33
30.00	140.00±39.69^{b}	+41.80	26.67.±11.55^{ab}	+33.35	13.33±5.77^{ab}	-11.13	31.67±6.64^{a}	-47.33
40.00	165.00±25.98^{ab}	+67.10	26.67.±11.55^{ab}	+33.35	13.33±5.77^{ab}	-11.13	31.67±6.64^{a}	-47.33
50.00	185.00±79.94^{ab}	+87.10	30.00±12.14^{c}	+50.00	12.56±4.70^{a}	-16.27	50.00±7.89^{ab}	-16.67

Means within the same column with different superscripts (a, b, ab, c, d) differ significantly (P<0.05). **Key: AST:** Aspartate aminotransferase; **ALT:** Alanine aminotransferase; **ACP:** Acid phosphatase; **ALP:** Alkaline phosphatase.

Table 2: Activities of selected enzymes in the muscle of *C. gariepinus* Adults exposed to Jumbo detergent for 30 days (Mean ± S.D).

Conc. (mg/L)	AST (IU/L)	% Control	ALT (IU/L)	% Control	ACP (IU/L)	% Control	ALP (IU/L)	% Control
0.00	442.50±80.05^{a}	100	19.50±5.23^{a}	100	10.33±5.16^{a}	100	192.50±11.55^{c}	100
10.00	442.50±80.05^{a}	0.00	21.00±7.32^{ab}	+7.70	10.40±8.56^{a}	+0.68	186.50±8.00^{c}	-3.12
20.00	444.25±80.26^{a}	+0.06	24.75±7.56^{ab}	+26.90	10.80±8.76^{a}	+4.55	173.60±8.87^{b}	-9.82
30.00	446.00±81.16^{a}	+0.79	25.50±8.00^{ab}	+30.80	10.80±7.06^{a}	+4.55	164.00±7.16^{b}	-14.81
40.00	443.00±81.16^{a}	+0.25	29.75±8.16^{b}	+52.56	10.95±10.06^{a}	+6.00	129.00±5.18^{ab}	-32.90
50.00	440.00±81.36^{a}	+0.56	31.75±12.23^{c}	+62.80	10.90±11.16^{a}	+5.52	109.00±4.19^{a}	-43.40

Means within the same column with different superscripts (a, b, ab, c) differ significantly (P<0.05). **Key: AST:** Aspartate aminotransferase; **ALT:** Alanine aminotransferase; **ACP:** Acid phosphatase; **ALP:** Alkaline phosphatase.

Harcourt, Rivers State, Nigeria and were transported in four of 50 L plastic containers to the laboratory of the Department of Fisheries and Aquatic Environment, Rivers State University of Science and Technology, Port Harcourt. Fish specimens were acclimated in a rectangular plastic aquarium containing 20 L of water each for 7 days. Detergent definitive tests of 10.00, 20.00, 30.00, 40.00 and 50.00 mg/L were obtained through a serial dilution process according to the report of Santanu (2013).

These specimens exposed to five treatment levels (five replicate each) in a Completely Randomized Design (CRD) for 30 days with exception to the control were cared for on regular basis by exchanging water solution (water with detergent) daily and to prevent escape aquaria were covered with a perforated cover. The containers were washed with a piece of foam and fish fed once daily with a 35% crude protein diet at 2% body weight for juvenile fish and 1% for adult fish (Gabriel and George, 2005).

Statistical analysis was done using statistics software 8.0 for windows. Two way analysis of variance (ANOVA) was employed to reveal significant differences in measured variables among control and experimental groups. When a difference was detected (P < 0.05), Turkey's multiple comparison test was applied to know which treatment is significantly different (Zar, 1996).

Blood samples collected from the fish (behind the anal fin) with 21G size needle and syringe for enzyme analysis was preserved in heparinized bottles. Fishes were killed with a blow on the head after blood collection and dissected in order to collect sample (0.5 g) of muscle (flesh) with the aid of a penknife. The sample was macerated with pestle and mortar. To prepare samples for enzyme 5 ml of physiological saline solution was used. After the addition of these diluents, samples were centrifuged at the rate of 300 rounds per minutes for 10 min. The supernatants were then removed and stored in plain bottles at – 4°C for analysis.

RESULTS

In the muscles of juvenile fish, it was observed that detergent elicited the activities of ACP by 0.68% at 10.00 mg/L; same level of 4.55% at 20.00 and 30.00 mg/L; 6.00% at 40.00 mg/L and 5.52% at 50.00 mg/L above control, while in adult fish the impact of detergents were all below control by 33.33, 11.13, 11.13, 11.13 and 16.27% at 10.00, 20.00, 30.00, 40.00 and 50.00 mg/L respectively. Hence, at 10.00, 20.00, 30.00, 40.00 and 50.00 mg/L, detergents had no adverse effect on ACP in adult fish when compared with juvenile fish (Tables 1 and 2). The activities of ALP in adult and juvenile were all significantly lower than the control (P>0.05) by 11.12, 47.33, 47.33, 47.33 and 16.67% for adult

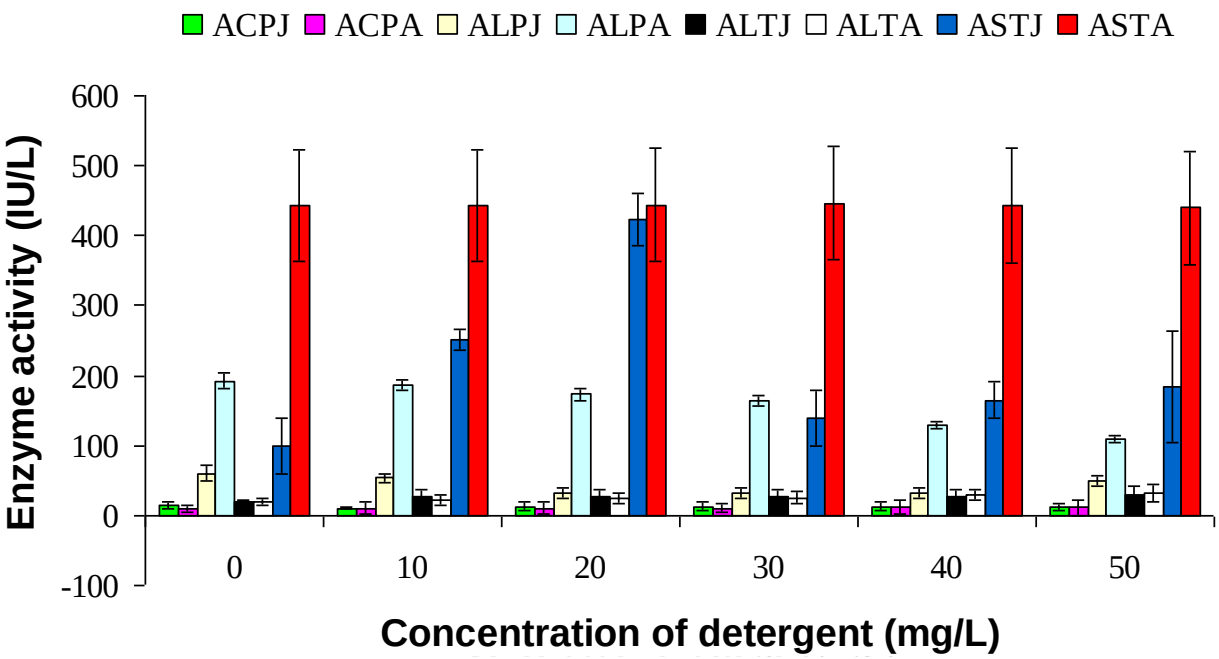

Figure 1: Comparative activities of enzymes in the muscle of juveniles and adults *C. gariepinus* exposed to jumbo detergent for 30 days (Mean ± S.D). **Key: ACPJ:** Acid phosphatase juvenile; **ACPA:** Acid phosphatas adult; **ALPJ:** Alanin phosphatase juvenile, **ALPA:** Alanin phosphatase adult, **ALTJ:** Alanin aminotransferase juvenile, **ALTA:** Alanine aminotransferase adult, **ASTJ:** Aspartate aminotransferase juvenile, **ASTA:** Aspartate aminotransferase adult.

and 3.12, 9.82, 14.81, 32.90 and 43.40% for juvenile fish at 10.00, 20.00, 30.00, 40.00 and 50.00 mg/L, respectively (Tables 1 and 2). ALT activities in both adults and juveniles were not significantly raised beyond control, however, at 10.00, 20.00 and 30.00 mg/L, ALT activities in adult fish was respectively 25.65, 6.35 and 2.45% higher than that of juvenile fish but lower by 19.21 and 29.45% at 40.00 and 50.00 mg/L (Tables 1 and 2). It was observed that AST activities in juvenile fish was not significantly raised (0.06% at 20.00 mg/L; 0.79% at 30.00 mg/L; 0.25% at 40.00 mg/L and 0.56% at 50.00 mg/L) above control (100%) whereas in adult fish detergent significantly raised the activities of AST by 154.90% at 10.00 mg/L; 328.69% at 20.00 mg/L, 41.80% at 30.00 mg/L, 67.10% at 40.00 mg/L and 87.10% at 50.00 mg/L (Tables 1 and 2). AST activities in the muscle of adult fish peaked at all the treatment levels were followed by that of juveniles at 20.00 mg/L. The ALP in the muscles of both life stages decreased with increase in detergent concentration, while ACP and ALT were at their barest minimum with increase in LAS concentration (Figure 1).

In the plasma, ACP activities were raised in adult fish by 50% at 10.00 and 20.00 mg/L and significantly above control by 108.33% at 30.00 mg/L; 133.33% at 40.00 mg/L and 160.83% at 50.00 mg/L, while at 10.00, 20.00, 40.00 and 50.00 mg/L ACP activities were all respectively below control by 36.54, 9.95, 68.59 and 47.64% in juvenile fish except at 30.00 mg/L where activities were higher than that of control by 5.76%. ALP and ALT activities in the plasma were raised above control in both life stages (adult and juvenile). In juvenile fish, ALP activities were higher than that of adult fish by 83.46% at 10.00 mg/L, 107.72% at 20.00 mg/L, 36.36% at 30.00 mg/L, 34.66% at 40.00 mg/L and 43.09% at 50.00 mg/L, while in ALT it was observed that activities in juvenile fish were 42.41% at 10.00 mg/L, 4.75% at 20.00 mg/L and 0.64% at 40.00 mg/L higher than that of adult and then 6.64% at 30.00 mg/L and 63.29% at 50.00 mg/L less when compared with the control. Interestingly, AST activities in adult fish were significantly respectively higher ($P<0.05$) than that of control by 48.83, 69.76, 100.00, 141.86 and 176, 74% at 10.00, 20.00, 30.00, 40.00 and 50.00 mg/L, while it was significantly lower ($P>0.05$) than control in the juvenile fish by 63.44% at 20.00 mg/L, 44.05% at 30.00 mg/L, 33.33% at 40.00 mg/L and 34.40% at 50.00 mg/L except at 10.00 mg/L where it was 112.90% above control (Tables 3 and 4). ALP in adult fish increased and peaked at 50.00 mg/L, while that of juvenile was within the same range with increase in detergent concentration. ACP, ALT and AST in both life stages fluctuated with increase in detergent concentration (Figure 2).

DISCUSSIONS

Elevated level of AST and ALT in *C. batrachus* exposed to detergent at sublethal concentration as reported by Datta et al. (2009) is not in total line with this work in that ALT

Table 3: Activities of selected enzymes in the plasma of *C. gariepinus* Juveniles exposed to Jumbo detergent for 30 days (Mean ± S.D).

Conc. (mg/L)	AST (IU/L)	%	ALT (IU/L)	%	ACP (IU/L)	%	ALP (IU/L)	%
0.00	23.25±6.95^{ab}	100	4.00±1.21^{a}	100	9.55±2.83^{a}	100	15.50±6.35^{a}	100
10.00	49.50±2.89^{c}	+ 112.90	6.00±2.31^{a}	+50.00	6.06±2.42^{a}	-36.54	29.00±1.12^{b}	+87.00
20.00	8.50±1.73^{a}	-63.44	5.00±2.01^{a}	+25.00	8.60±0.58^{a}	-9.95	33.50±2.89^{ab}	+116.10
30.00	13.00±3.45^{a}	-44.05	5.00±2.00^{a}	+25.00	10.10±7.04^{a}	+5.76	24.00±1.26^{b}	+54.80
40.00	15.50±5.57^{a}	-33.33	6.00±2.31^{a}	+50.00	3.00±1.15^{a}	-68.59	25.00±1.15^{b}	+61.29
50.00	15.25±4.50^{a}	-34.40	4.00±0.10^{a}	0.00	5.00±1.73^{a}	-47.64	28.50±5.21^{b}	+83.87

Means within the same column with different superscripts (a, b, ab, c) differ significantly (P<0.05). **Key: AST:** Aspartate aminotransferase, **ALT:** Alanine aminotransferase, **ACP:** Acid phosphatase, **ALP:** Alkaline phosphatase.

Table 4: Activities of selected enzymes in the plasma of *C. gariepinus* adults exposed to Jumbo detergent for 30 days (Mean ± S.D).

Concentration (mg/L)	AST (IU/L)	% Control	ALT (IU/L)	% control	ACP (IU/L)	% Control	ALP (IU/L)	% control
0.00	10.75±0.02^{a}	100	19.75±0.50^{a}	100	1.20±0.06^{a}	100	134.25±1.90^{a}	100
10.00	16.00±0.07^{ab}	+48.83	21.25±0.70^{ab}	+7.59	1.80±0.08^{ab}	+50.00	139.00±1.90^{a}	+3.54
20.00	18.25±0.10^{ab}	+69.76	23.75±1.00^{ab}	+20.25	1.80±0.10^{b}	+50.00	145.50±2.04^{ab}	+8.38
30.00	21.50±1.00^{b}	+100.00	26.00±1.10^{ab}	+31.64	2.50±0.12^{b}	+108.33	159.00±2.07^{b}	+18.44
40.00	26.00±1.32^{b}	+141.86	29.50±1.40^{b}	+49.36	2.80±0.17^{c}	+133.33	170.00±2.10^{b}	+26.63
50.00	29.75±1.90^{c}	+176.74	32.25±1.70^{c}	+63.29	3.13±0.18^{c}	+160.83	189.00±2.20^{b}	+40.78

Means within the same column with different superscripts (a, b, ab, c) differ significantly (P<0.05). **Key: AST:** Aspartate aminotransferase; **ALT:** Alanine aminotransferase; **ACP:** Acid phosphatase; **ALP:** Alkaline phosphatase.

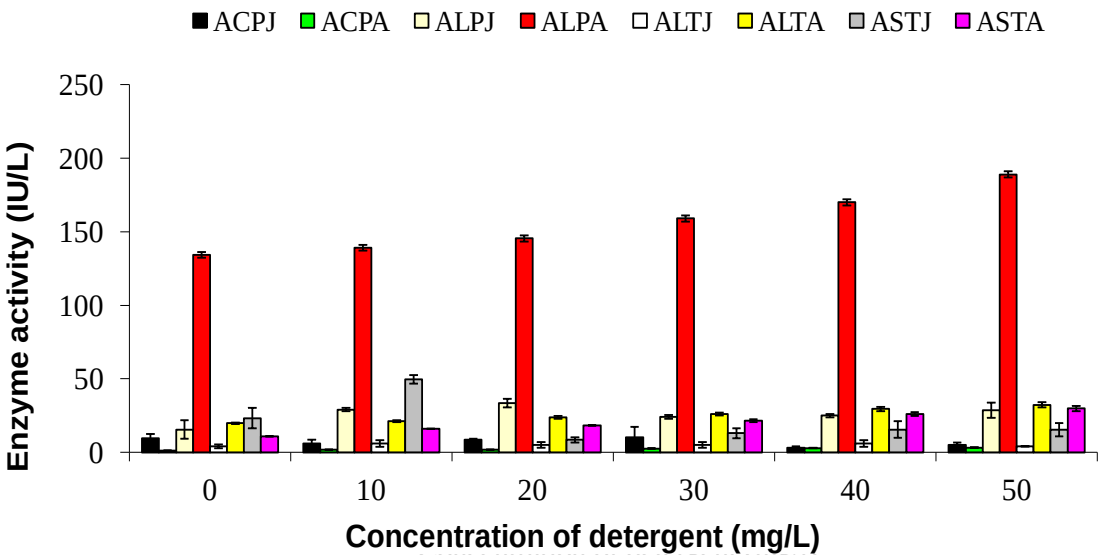

Figure 2: Comparative activities of enzymes in the plasma of juveniles and adults *C. gariepinus* exposed to detergent for 30 days (Mean ± SD). **Key: ACPJ:** Acid phosphatase juvenile; **ACPA:** Acid phosphatas adult; **ALPJ:** Alanin phosphatase juvenile; **ALPA:** Alanin phosphatase adult; **ALTJ:** Alanin aminotransferase juvenile; **ALTA:** Alanine aminotransferase adult; **ASTJ:** Aspartate aminotransferase juvenile; **ASTA:** Aspartate aminotransferase adult.

activities in both adult and juvenile fishes were not significantly raised beyond the control, however, at 10.00, 20.00 and 30.00 mg/L, ALT activities in adult fish was respectively 25.65, 6.35 and 2.45% higher than that of juvenile fish but lower by 19.21 and 29.45% at 40.00 and 50.00 mg/L, respectively. In addition, AST activities in

juvenile fish was not significantly raised (0.06% at 20.00 mg/L; 0.79% at 30.00 mg/L; 0.25% at 40.00 mg/L and 0.56% at 50.00 mg/L) above the control (100%), whereas in adult fish detergents significantly raised the activities of AST by 154.90% at 10.00 mg/L; 328.69% at 20.00 mg/L, 41.80% at 30.00 mg/L, 67.10% at 40.00 mg/L and 87.10% at 50.00 mg/L, respectively.

Detergents can alter the activities of many enzymes especially those involved in the cellular glucose uptake, gluconegenesis, fatty acid oxidation and production of glutathione due to its sulfhydryl group binding capability. Arthur (1970) corroborated with the findings in this work, where in the muscles of juvenile fish, it was observed that detergents elicited the activities of ACP by 0.68% at 10.00 mg/L; same level of 4.55% at 20.00 and 30.00 mg/L; 6.00% at 40.00 mg/L and 5.52% at 50.00 mg/L above the control while in adult fish the impact of detergents were all below control by 33.33, 11.13, 11.13, 11.13 and 16.27% at 10.00, 20.00, 30.00, 40.00 and 50.00 mg/L, respectively. Hence, at 10.00, 20.00, 30.00, 40.00 and 50.00 mg/L, detergents had no adverse effect on ACP in adult fish when compared with juvenile fish. The activities of ALP in adults and juveniles were all significantly lower than the control ($P>0.05$) by 11.12, 47.33, 47.33, 47.33 and 16.67% for adults and 3.12, 9.82, 14.81, 32.90 and 43.40% for juvenile fishes at 10.00, 20.00, 30.00, 40.00 and 50.00 mg/L, respectively.

Homtsoe et al. (2007) reported significant alteration in liver AST and ALT in *Labeo rohita* exposed to detergents which reflects significant increase in structure and function of cell organelles like endoplasmic reticulum and membrane transport system. This is in line with this study that indicated increase in detergent concentration in the plasma and liver AST, ALT, ACP, and ALP for both sizes of fishes, as activities increased with exception to adult ALT in the liver and AST in juvenile fish where irregularities were recorded in the liver and decrease in the plasma. Luskova et al. (2001) reported that *Cyprinus carpio* exposed to 32.5 mg/L of detergent for 96 h decreased enzymes (AST, ACP and ALP) activities in the plasma of the fish. This is not in line with the findings in this work as AST, ACP and ALP values in both sizes of fish increased with increase in detergent concentration except in juvenile AST and ACP.

Breth and Grooves (1979) reported that increases in plasma ACP, AST and bilirubin generally point to some sort of hepatic damage. Chamber (1978) and Michael (1991) reported that shrimps when exposed to different types of crude oil and surfactants (LAS) led to increase in enzymatic activities. This is in line with this work in that in the plasma, ACP activities were raised in adult fish by 50% at 10.00 and 20.00 mg/L and significantly above control by 108.33% at 30.00 mg/L; 133.33% at 40.00 mg/L and 160.83% at 50.00 mg/L and was not in line with the study where at 10.00, 20.00, 40.00 and 50.00 mg/L ACP activities were all respectively below control by 36.54, 9.95, 68.59 and 47.64% in juvenile fish except at 30.00 mg/L where activities was higher than that of control by 5.76%. ALP and ALT activities in the plasma were raised above control in both life stages (adults and juveniles). In juvenile fish, ALP activities were higher than that of adult fish by 83.46% at 10.00 mg/L, 107.72% at 20.00 mg/L, 36.36% at 30.00 mg/L, 34.66% at 40.00 mg/L and 43.09% at 50.00 mg/L, while in ALT it was observed that activities in juvenile fish were 42.41% at 10.00 mg/L, 4.75% at 20.00 mg/L and 0.64% at 40.00 mg/L higher than that of adult and then 6.64% at 30.00 mg/L and 63.29% at 50.00 mg/L less when compared with the control. The claim that activity levels of AST and ALT studied in muscles, gills, liver and brain of *T. mozambica* exposed to detergent showed that transaminases were elevated in all the tissues in addition to a shift in aminotransferases reaction under surfactants impacts as reported by Sprague (2003) whose findings is in line with this work as it was observed that AST activities in adult fish were respectively higher ($P<0.05$) than that of the control by 48.83, 69.76, 100.00, 141.86 and 176.74% at 10.00, 20.00, 30.00, 40.00 and 50.00 mg/L, respectively, while the reverse was seen in juvenile fish where it was significantly lower ($P>0.05$) than the control by 63.44% at 20.00 mg/L, 44.05% at 30.00 mg/L, 33.33% at 40.00 mg/L and 34.40% at 50.00 mg/L except at 10.00 mg/L where it was 112.90% above control. ALP in adult fish increased and peaked at 50.00 mg/L, while that of juvenile was within the same range with increase in detergent concentration. ACP, ALT and AST in both life stages fluctuated with increase in detergent concentration. Thus, a decrease may denote a decrease in metabolic transport (Begun, 2004). Alanine phophatase also functions in the conversion of nicotinamide adenine dinucleotide phosphate to nicotinanide adenine dinucleotide (Ghem et al., 2003).

The decrease in ALP activity after exposure will eventually result in a shift in biosynthesis and energy metabolic pathway of the exposed organism (Ovuru and Mgbere, 2000; Uedeme-Naa and Gabriel, 2017). Sastry and Sharma (1980) reported decreased activities of alkaline and phosphates in the brain of *Channa puctatus* following the effects of detergent.

Conclusion

The level of enzyme alterations in the two organs as compared with the control is a clear indication that most aquatic organisms exposed to anthropogenic substances in our water bodies are endangered species and stands the risk of either becoming extinct or gonads badly affected which could hinder reproduction. More recently, changes in enzyme concentrations are being employed in the evaluation of toxicological responses (Adams et al., 1996) for rapid detection or to predict early warning of xenobiotic toxicity. On this note, more research into genotoxity and early life stages of fishes should be highly encouraged to curb the extinction of fishes due to some deleterous xenobiotics released into our water bodies knowingly or

unknowlingly (Uedeme-Naa and George, 2019).

REFERENCES

Arthur JW (1970). Chronic effects of Linear alkylate sulfonate detergent on *Clarias betrachus*. Water Res. 4: 451-257.

Begun G (2004). Carbofusan insecticide induced Biochemical alterations in liver and muscle tissues of fish, *Clarias batrachus* (Linn) and recovery response. Aquatic Toxicology. 66 (1): 83 – 92.

Breth JR, Grooves TD (1979). Physiological energetic. In: Hoar, W.S., Randall D.J. and Brett, J.R. Eds. *Fish Physiology.* New York, Academic Press.

Carrey J, Almoth BC (2008). Toxicity of in organic aluminium in Stream bioassays with brown trout (Salmo Trutta) *Science of the Total Environment.* 437: 422-432.

Chamber JE (1978). Biochemical mechanisms contributing to species different in insecticide toxicity. Toxicol. 105: 291–304.

Datta S, Gush D, Saha DR, Bhattacheraya S, Mazunder S (2009). Chronic exposure to ions concentration of arsenic immonotoxic to fish. Aquatic Toxicol. 92: 86-94.

Fafoye OO, Adebisi AA, Fagade SO (2004). Toxicity of *Parkia biglobosa* and *Raphia vinifus* extracts on *Clarias gariepinus* juveniles. Afr. J. Biotechnol. 3(11): 627-630.

Gabriel UU, George ADI (2005). Plasma enzymes in *Clarias gariepinus* exposed to chromic levels of round up (glyphosate). Environment and Ecology. 23: 271–276.

Ghem TT, Balogun JK, Lawal FA, Anunne PA, Auta J (2003). Sub-lethal effects of Tannery Effluent on some Haematological indices and growth of *Clarias gariepinus* (Tuegels). Contamination Toxicol. 71: 1200-1206.

Homtsoe N, Davwdi R, Chavan B (2007). Effects of effluents from industry on the enzymes of Rohu carp (*Labeo rohita).* Bulletin Zool. 14:17-19.

Luskova V, Svobodova M, Kolarova J (2001). The effects of diazinon on blood plasma Biochemistry of Carp (*Cyprinus carpio*). Acta Veterinary. 71: 117-123.

Michael AL (1991). Chronic and subleathal toxicities of surfactants to aquatic animals: A review and risk assessment. Water Resources. 25 (1): 101-113.

Nath K, Kumar N, Morh S (2008). Hexavalent chromium toxicity and its impact on certain aspects of carbohydrate metabolism of the freshwater teleost. *Colisa fasciators.* Science of the Total Environment. 23 (2): 234-245.

Omoniyi I, Agbon AO, Sodunke SA (2002). Effect of lethal and sublethal concentrations of tobacco (*Nicotiana tobaccum*) leaf dust extracts on weight and haematological changes in *Clarias gariepinus*. J. Appl. Sci. Environ. Manag. 6(2): 37 – 41.

Ovuru SS, Mgbere OO (2000). Enzyme changes in shrimps (*Penaeus notialis*) following a brief exposure to weathered Bonny light crude oil. *Delta Agriculture.* 7: 62 – 68.

Pienaar U (1991). The freshwater Fishes of the Kruger National Park. Republic of South Africa: The National Parks Board of Trustees of the Republic of South Africa.

Santanu S (2013). Effect of sub-lethal exposure of detergent on transamination in liver of *Heteropnustes fossilis*. Int. J. Pure Appl. Biosci. 1 (5): 36-41.

Sastry KV, Sharma K (1980). Diazinon effects on the activities of brain enzymes from *Ocephalus punctatus* (*Channa*). Contaminal Toxicol. 24: 326 – 332.

Singh AR, Banerjee TK (2008). Toxic effects of sodium arsenate on the skin epidermis of air breathing catfish. *Vetrirarski Archives.* 78(1): 73-88.

Skelton P (2001). *A Complete study on the Freshwater Fishes of Southern Africa*. Struik Publishers.

Sprague JH (2003). U.V Ozonation of Paraquat. J. Agric. food Chem. 33: 190-210.

Svoboda M (2001). Stress in fish. *Bulletin of Research Institute of Fish Culture and Hydrobiogy.* 37: 169-191.

Teugels G (1986). A systematic revision of the African species of the genus *Clarias* (Pisces; Clariidae). Aquac. Res. 247: 1-199.

Uedeme-Naa B**,** Gabriel UU (2017). Plasma enzymes in the gill of *Clarias gariepinus* juvenile exposed to chronic levels of linear alkyl benzene sulphonate. Appl. Sci. Reports. 19 (3): 95-98

Uedeme-Naa, B. and Erondu, E.S. (2016): Influence of Linear alkylbenzenesulphonate on some plasma biochemical parameters of freshwater fish (*Clariasgariepinus*) Juvenile. *Journal of Technology and Education in Nigeria.*14(1): 8-16.

Viran R, Erkoc FU, Polat H, Kocak O (2003). Investigation of acute toxicity of deltamethrin on guppies (*Poecitia reticulate)*. Ecotoxicol. Environ. Safety. 55: 82-85.

Walpita CN, Grommen SVH, Darras VM, Van der Geyten S (2007). The influence of stress on thyroid hormone production and pheripheral deiodination in Nile tilapia (O*reochromis niloticus).* General Comparative Endocrinology. 150: 18-25.

Wells RMG, Meintyre RH, Morgan AK, Devie PS (1986). Physiological stress responses in big genefish after capture: observation on plasma chemistry and blood factors. Comparative Biochemistry and Physiology. 84: 565 – 571.

Zar JH (1996). *Biostastical Analysis.* 3rd ed., prentice Hall, New Jersey, USA.

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