PAT June, 2014; 10 (1): 151-163 ISSN: 0794-5213

Online copy available at

www.patnsukjournal.net/currentissue

Plasma and Enzymatic Indices of *Chrysichthys nigrodigitatus* At The Bariga Landing Site, Lagos Lagoon

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Abstract
As human population increases with the growth of industrialization, there is a resultant increase in the rate of pollution in aquatic ecosystems. Changes in plasma concentrations can be indicative of stress in fishes exposed to pollutants. This study investigated the toxicity and plasma indices changes in Chrysichthys nigrodigitatus of Bariga landing site, Lagos lagoon. Physiochemical parameter of Bariga landing site (Lagos lagoon) were also analyzed. Temperature, pH, dissolved oxygen, salinity, transparency had a mean of 25±1.0, 7.44±0.05, 4.33±0.15, 15.33±3.06, 73.17±0.76 respectively. TSS, phosphate, COD, BOD, nitrate, TDS had a mean value of 2.0±0.58, 2.0±0.58, 13.1±1.015, 8.87±0.23, 5.3±0.1, 161.13±9.50 respectively. The mean value of AST, ALT, ALP, CHOL, GLU, TP enzymes activity in the plasma of Chrysichthys nigrodigitatus from the month of May to July are 48.26±77.54, 21.79±13.49, 62.10±44.198, 86.21±27.64, 51.18±10.78, 24.58±14.10 respectively. The AST, ALT, ALP found within the cells of the liver, kidney, gills were high in the plasma of Chrysichthys nigrodigitatus which may be due to tissue injury or organ dysfunction caused by stress. The reduction in cholesterol, glucose and total protein concentration was due to exposure to stress by pollutant. The Biochemical profile of fish proves to be a sensitive index for the evaluation of fish metabolism under oxidative stress from the lagoon. However, the biochemical parameters of blood plasma in this study showing its usefulness as a tool in monitoring the physiological status of fish and as an indicator of the aquatic environmental health.

Keywords*: Bioindicator, Plasma Indices, Fish, Lagos Lagoon*

Introduction

Increase in human population has brought about an increase in fish production, recreation and navigation offered by lagoons and this has put enormous pressure and stress on the quality of lagoon water. The impact of human activities is noticed on physical and chemical properties of water and on the organism in the water body. The increase of human population yearly and with the rapid development of industrialization resulted in the increase of pollution in aquatic environment (Caussy *et al*., 2003). Water pollution is caused by industrial waste materials, agricultural insecticides and surplus fertilizers, natural and domestic wastes, heavy metals and sewage that are released into water. The effect on aquatic life also reaches humans through the food chain.

Cells contain enzymes for their proper functions such that damages to cellular membrane lead to their escape into the blood where their activities can easily be measured as an index of cell integrity (Coppo *et al.,* 2002). However, part of serum

chemistry could be used to identify tissue damage (Patti and Kulkarni, 1993). Aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP) are normally found within the cells of the liver, heart, gills, kidneys, muscles and organs (Shalaby, 2009) but their increase in the plasma indicate tissue injury or organ dysfunction (Wells *et al.,* 1986). However, changes in plasma and enzymes profile can be indicative of a classical general adaptive response to stress in fishes exposed to pollutants (Martinez *et al.,* 2004). This is due to sensitivity of fish blood to pollution-induced stress (Patti and Kulkarni, 1993).

Blood is highly susceptible to internal and external environment fluctuations because it is the vehicle for the transport of pollutants (Blaxhall, 1972). Pollutants are transported in the blood stream by binding to specific plasma proteins (Joseph *et al.,* 2010).

Biochemical characteristics of blood are among the important indices of the status of internal environment of the fish (Edsall, 1999). Variation in the biochemical blood characteristics of an organism, which is due to effects of various pollutants, makes it possible to study the mechanisms of the effects of these substances (Edsall, 1999).

Alkaline phosphatase (ALP) is a hydrolase enzyme which is responsible for removing phosphate groups from many types of molecules, including alkaloids, nucleotides, and proteins, (Kim and Wyckoff, 1991).

The measurement of Cholesterol is used in the diagnosis and treatment of lipid lipoprotein metabolism disorders. Lipids play an important role on the body, they serve as hormones or hormone precursors, aid in digestion, provide energy, storage and metabolic fuels, act as functional and structural components in biomembranes and form insulation to allow nerve conduction and prevent heat lost (Mousa *et al.,* 2008). The use of cholesterol oxidase following specimens' saponification provided the first step towards a totally enzymatic procedure. Glucose is an important cellular content and energy rich compound present in various body tissues. Decrease in glucose levels after prolonged exposure of living cells to toxic environments was due to the activation of the enzyme involved in carbohydrate metabolism (Nagabhushanam and Kulkarni, 1981). Biochemical changes in fishes exposed to various pollutants have been documented (Attar, 2005; Ogueji and Auta, 2007; Kori-Siakpere and Ubogu, 2008; Shalaby, 2009).

Fish is reliable component of an aquatic monitoring system because they integrate the effect of detrimental environmental changes as consumers which are relatively high in the aquatic food chain. Fish plays an increasingly important role in the monitoring of water pollution because it responds with great sensitivity to changes in the aquatic environment. The sudden death of a fish indicates heavy pollution; the effects of exposure to sublethal levels of pollutants can be measured in terms of biochemical, physiological or behavioural responses of the fish. Fish is good biosensors of aquatic contaminants (Kumari *et al.,* 2011).

Biochemical markers are measurable responses to the exposure of an organism to xenobiotics. They usually respond to the mechanism of toxic activity. Biochemical markers detect the type of toxicity; in some of them, the magnitude of their response correlates with their level of pollution. The biochemical markers can detect early responses and pre-pathological alterations before other disturbances as mortality, disease or population changes occur in the ecosystem (Kumari *et al.,* 2011).

Fish live in contact with their environment, and are very susceptible to physical and chemical changes which may be reflected in their blood components (Wilson and Taylor, 1993).

The survival and reaction of aquatic animals depend not only on the biological state of the animals but also on the toxicity, and type and time of exposure to the toxicant (Brungs *et al*., 1977).

Biochemical profile in fish proves to be a sensitive index for the evaluation of fish metabolism under oxidative stress from the lagoon. However, there are no studies demonstrating the changes in blood biochemistry of fishes exposed to a polluted lagoon. The biochemical parameters of blood plasma are useful in monitoring the physiological status of fish and as indicators of the aquatic environmental health (Rehulka and Parova, 2000; Rehulka and Minarik, 2001; Dobšikova *et al*., 2009). Hence, this study investigated the toxicity and plasma indices changes in *Chrysichthys nigrodigitatus.*

Material and Methods

Description of Study Site

The Bariga landing site is a commercial fishing site where fisher of the community takes fishing as a form of empowering themselves. The Global positioning system of the sampling site is 6 ^{o} 31’29’’E and 3 ^{o} 23’58’’ N aligned with the Lagos lagoon. The Bariga landing site’s edges are covered with grasses, herbs and a few scattered shrubs. *C. nigrodigitatus* and other species of fishes were the fish caught from the Bariga landing site. Fishing with hooks and lines is a common human activity. The landing site is polluted as a result of anthropogenic activities. The Lagos lagoon is part of the continuous system of lagoons and creeks that are found along the coast of Nigeria from the border with the Republic of Benin to Niger-Delta. This lagoon bordering the Lagos Island is located between longitude 3^{o}10’ and 3^{o}45’ E and 6^{o}15’N and 6^{o}36’.N. It stretches for about 257 km from Cotonuo in the Republic of Benin to the Western edge of the Niger-Delta. The lagoon boarders the forest belt and receives input from a number of important large rivers draining more than 103,626 km of the country (Ajao, 1996).

Experimental Set-Up

The specie of commercial important caught from the Bariga landing site of the Lagos lagoon were used in the experiment was *C. nigrodigitatus. Chrysichthys nigrodigitatus*

specimens were captured monthly at the sample stations during the study period (April – June 2012), using gill nets (50 – 120mm stretch mesh size), baited hooks and traps set overnight prior to collection. The fish were washed in flowing water to remove adhering dirt, transported in polythene bags to the laboratory.

Physio - Chemical Analysis

Physiochemical parameters of the Lagos lagoon were collected and analyzed for 3months. The parameters measured are temperature, dissolved oxygen, salinity, transparency, pH, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD).

Determination of Temperature

The temperature of the water was determined using a mercury-in-glass thermometer. The thermometer is calibrated in degree Celsius. It measures the maximum temperature of the day.

Determination of pH

The pH was determined using pH (model 9405) with glass electrode. The electrodes were standardized using buffer solution and then washed with distilled water. The meter was then dipped into the water and pH read on scale.

Determination of Dissolved Oxygen

The dissolved oxygen was measured using appropriate digital instruments (Horiber U-10) of the water throughout the experiment. The measurement is carried by inserting the probe into water and the readings were taken.

Salinity (%)

The salinity of the water samples was determined in-situ using a hand held refractometer. A drop of the water sample was placed on the prime of the meter of the refractometer and the meter was adjusted to 0% marks and viewed through the eye piece. The daylight plate was closed and the salinity of the water sample read on the scale.

Turbidity

The turbidity is a measure of the amount of light penetration into an aquatic system. The turbidity of the water samples at the study site were measured using the Horiba water checker, model U-10 probe.

Biochemical Oxygen Demand (BOD)

This is a measure of the amount of the oxygen that is removed from the water sample due to natural biological assimilation or degradation of organic compounds by the organisms present, especially bacteria. The Biochemical Oxygen Demand for the water samples from the study area were determined taking the difference between the DO content of the samples on the day of the sample collection and then 5 days after the

samples were collected. The water samples were incubated at 20°C for five days. Measurement of the 5-day DO was carried out using the same Horiba water checker (Model U-10) used to measure the DO during the sampling period.

Biochemical Parameters

Malondialdehyde (MDA)

The levels of homogenized tissue MDA, as an index of lipid peroxidation were determined by thiobarbituric acid reaction (TBARS Assay). In this method, malondialdehyde is measured spectrophotometrically at absorbance levels of 535 nm to assay for the extent of lipid peroxidation in a sample.

Procedures

0.1ml of tissue homogenate (Tris-HCl buffer, pH 7.5) was treated with 2ml of (1:1:1 ratio) TBA- TCA HCl reagent (Thiobarbituric acid 0.37%, 0.25N HCl and 15% TCA) and placed in water bath for 15mins, cooled and centrifuged at room temperature for 10mins at 1,000rpm.

Enzymes Activity Assays

Superoxide Dismutase (SOD)

The SOD enzyme assay determined the difference between superoxide anion decomposition and production i.e. its ability to inhibit the autoxidation of epinephrine. Enzyme activity was monitored at absorbance level of 450 nm. Concentrations are expressed as SOD Unit/ mg protein or U/mg, where one unit is defined as the amount of enzyme needed to inhibit 50% epinephrine reduction per minute and per milligram of protein at 25◦C and pH 7.8.

Reduced Glutathione (GSH)

Glutathione (GSH) was determined in the 10, 000 g supernatant fraction of the liver and gills homogenates of two fishes according at 412 nm using 5,5'-dithio-bis-2-nitrobenzoic acid (DTNB).

Total Protein Estimation

The protein content of the various fractions was estimated by the method of Lowry *et al*., (1951) using bovine serum albumin as standard.

Biochemical Analysis

Two micro litres/litres of blood sample of the test organisms were collected and taken to the Laboratory for biochemical analysis. The blood serum was centrifuged to obtain the plasma used for the experiments.

Determination of Cholesterol

The cholesterol is determined after enzymatic hydrolysis and oxidation. The indicator quinoneimine was formed from hydrogen peroxide and 4-aminoantiprine in the presence of phenol and peroxidase. Ten micro litres of sample were mixed with 10µl of distilled water, 10µl standard and 1000µl of the reagent. The mixture was incubated for 10minutes at 20 - 25^0C. The absorbance of the sample and standard were measured against the reagent blank within 60 minutes with the aid of spectrophotometer.

Determination of Total Protein (TP)

The determination of total protein is through a standard procedure performing a new gain calibration with a curvette containing fresh diluted water. A total protein program in test screen was selected and carried out using water blank. The mixed sample and reagent were incubated for 30min at 20- 25^0C.

Determination of Glucose

The test for glucose was carried out using glucose kit containing buffer, enzyme and standard solution. 15µl/L of the buffer was added to the enzymes.

Determination of Alkaline Phosphatase (ALP)

The determination of the alkaline phosphatase was done by using a standard procedure at room temperature with wavelength Hg 405nm. The samples measured at 0.02µl/L were mixed with 1.0µl/L of reagent. After mixing the sample with reagent, the initial absorbance values were recorded and the timer was started simultaneously.

The ALP activities were calculated using the formula:

U/l = 2760 x Δ A 405nm/min

Determination of Aspartate Aminotransferase (AST)

The determination of aspartate aminotransferase was done through standard procedures. A volume of 0.1µl/L of sample were mixed with 0.1µl/L distilled water and 0.5µl/L of reagent (R1-buffer) and incubated at exactly 30mins at 37^0C. A volume of 0.5µl/L of a second reagent (R2- 2, 4-dinitrophenylhydrazine) was then added to the incubated mixture and allowed to stand for exactly 20minutes at 20- 25^0C. Five micro litres/litres of already prepared Sodium Hydroxide solution was then added to the mixture. The absorbance of the sample was read against the reagent blank after 5mintues. The activity of AST was obtained through a standard curve.

Determination of Alanine Aminotransferase (ALT)

The value of alanine aminotransferase was obtained through standard procedures at wavelength Hg 546nm and incubation temperature of 37^0C. A volume of 0.1µl/L of sample were mixed with 0.1µl/L distilled water and 0.5µl/L of reagent (R1-buffer) and incubated at exactly 30mins at 37^0C. The value of 0.5µl/L of the second reagent (R2- 2,

4-dinitrophenylhydrazine) was then added to the incubated mixture and allowed to stand for exactly 20minutes at 20- 25^{0}C. 5.0µl/L of already prepared Sodium Hydroxide solution was then added to the mixture. The absorbance of the sample was read against the reagent blank after 5mintues. The activity of ALT was obtained through a standard curve.

Statistical analysis

The means and standard error of means as well as one-way analysis of variance (ANOVA) for statistical significance ($P < 0.05$) was determined using Duncan Multiple Range Test while error bars were created using Microsoft® Office Excel programme and SPSS version18 window.

Results

Physico-Chemical Parameters

The physico-chemical parameters of the water of the Lagos lagoon were collected for analysis between (May-July, 2012). Water samples were collected to estimate the water quality which dictates the environmental status at the Lagos lagoon. Temperature ranges from 24.0-26.0°C with the highest value recorded in July and lowest temperature was recorded in June.

Salinity ranges from 12‰ to 18‰ with the highest salinity recorded in may at high tide and the lowest value recorded in June at both high and low tides. The dissolved oxygen ranges from 4.2mg/l to 4.5mg/l with the highest D.O recorded in June while the lowest was recorded in May.

Biochemical Oxygen Demand values ranges from 8.6mg/l to 9.0mg/l, the highest value was recorded in July while the lowest value was recorded in May. The pH recorded ranged from 7.40 to 7.50 with the highest pH recorded in July while the lowest was recorded in June. Phosphate ranged from 2.0 mg//l to 2.1mg/l with the highest recorded in June and the lowest value was recorded in June. Nitrate ranged from 5.2mg/l to 5.4mg/L, the highest was recorded in July and the lowest was recorded in June.

Biochemical Parameters

Malondialdehyde - (MDA) (Nmol/ml)

The mean MDA in the blood of *Chrysichthys nigrodigitatus* caught from the Lagos lagoon at different months that is between July to August ranged from 4.34 to 6.43nmol/ml (Table 1). The analysis of variance (ANOVA) results of the lipid peroxidation assay indicates that the level of MDA in the blood of the fish at the Lagos lagoon shows that there was a significant difference ($P < 0.05$). Further ANOVA post-hoc test using DMRT showed there was a significant difference ($P < 0.05$) in the MDA of the fish.

Table 1: The Mean Value of The Physiochemical Parameter of The Lagos Lagoon From May - July (Bariga Site).

Parameters	Mean values	FEPA 1999
Temperature (◦C)	25.0±1.0	29^{o}C
pH	7.44±0.05	6-9
Dissolved oxygen(mg/l)	4.33±0.15	5.0
Salinity (‰)	15.33±3.06	NS
TSS	2.0±0.58	NS
Po_4^{3-}(mg/l)	2.0±0.58	5
$No3^{-}$ (mg/l)	5.3±0.1	20
COD	13.1±1.015	NS
BOD	8.87±0.23	50
Transparency(cm)	73.17±0.76	NS
TDS	161.13±9.50	2000

Superoxide Dismutase – (SOD) (Min/mg/pro)

The mean SOD in the blood of *Chrysichthys nigrodigitatus* caught from the Lagos lagoon at different months that is between July to August ranged from 23.81 to 32.30 min/mg/pro (Table 1). The analysis of variance (ANOVA) result of the Superoxide Dismutase assay indicates that the level of SOD in the blood of the fish at the Lagos lagoon shows that there was a significant difference ($P < 0.05$). Further ANOVA post-hoc test using DMRT showed there was a significant difference ($P < 0.05$) in the SOD of the fish.

Estimation of Reduced Glutathione - (GSH) (µmol/ml)

The mean GSH in the blood of *Chrysichthys nigrodigitatus* caught from the Lagos lagoon at different months that is between July to August ranged from 0.30 to 0.49µmol/ml (Table 1). The analysis of variance (ANOVA) result of the reduced Glutathione assay indicates that the level of GSH in the blood of the fish at the Lagos lagoon shows that there was a significant difference ($P < 0.05$). Further ANOVA post-hoc test using DMRT showed there was a significant difference ($P < 0.05$) in the GSH of the fish.

Total Protein (g/l)

The mean total protein in the blood of *Chrysichthys nigrodigitatus* caught from the Lagos lagoon at different month that is between July to August ranged from 31.69 to 43.39g/l (Table 1). The analysis of variance (ANOVA) result of the total protein indicates that the level of TP in the blood of the fish at the Lagos lagoon shows that

there was a significant difference ($P < 0.05$). Further ANOVA post-hoc test using DMRT showed there was a significant difference ($P < 0.05$) in the total protein content in blood of the fish.

Table 2: Biochemical Parameters of Black Jaw Tilapia (*Sarotherodon melanotheron*) and Bagrid Catfish (*Chrysichthys nigrodigitatus)* in the Lagos lagoon.

	Enzymatic Biomarker in *Chrysichthys nigrodigitatus*			
	TOTAL PROTEIN (g/l)	SOD (Min/mg/pro)	MDA (Nmol/ml)	GSH (µmol/ml)
Week 1	35.44 ± 1.99^{bc}	26.89 ± 2.53^{abc}	6.26 ± 0.32^{c}	0.43 ± 0.02^{c}
Week 2	39.76 ± 1.27^{d}	29.93 ± 2.35^{bc}	5.79 ± 0.14^{bc}	0.49 ± 0.01^{d}
Week 3	36.25 ± 0.30^{c}	24.58v1.04^{ab}	6.43 ± 0.20^{c}	0.38 ± 0.01^{b}
Week 4	43.39 ± 0.46^{e}	23.81 ± 1.25^{a}	5.32 ± 0.08^{b}	0.33 ± 0.01^{a}
Week 5	31.69 ± 0.49^{a}	32.30 ± 1.85^{c}	5.49 ± 0.26^{b}	0.31 ± 0.01^{a}
Week 6	32.94 ± 0.77^{ab}	29.66 ± 1.49^{abc}	4.34 ± 0.34^{a}	0.30 ± 0.02^{a}
Mean±SD	36.58±0.88	27.86±1.76	5.62±0.22	0.37±0.01

Pooled standard error; Means in the same column with the same superscript are not significantly different from each other.

Biochemical Analysis

The plasma indices were estimated using *Chrysichthys nigrodigitatus* at the Bariga landing site of the Lagos lagoon.

Aspartate Aminotransferase (AST)

The Aspartate Aminotransferase in the plasma of *Chrysichthys nigrodigitatus* was estimated with the lowest value recorded in July with 17.37 and the highest value recorded in May with 122.85. The Analysis of variance showed that there was a significant difference ($P < 0.05$). Further post-hoc analysis was carried out using the Duncan Multiple Range test (DMRT) which showed that there was no significant difference ($P > 0.05$).

Table 3*:* Plasma membrane indices of *Chrysichthys nigrodigitatus* at the Bariga landing site, Lagos lagoon

Sampling Period	AST	ALT	ALP	CHOL	GLU	TP
MAY	122.85 ± 4.53^{c}	23.47 ± 2.60^{b}	113.34 ± 8.97^{b}	106.98 ± 6.65^{b}	48.50 ± 2.38^{b}	19.47 ± 0.87^{b}
JUNE	92.41 ± 6.78^{b}	35.28 ± 1.26^{c}	40.11 ± 6.39^{a}	97.12 ± 0.98^{b}	62.23 ± 0.84^{c}	10.66 ± 0.81^{a}
JULY	17.37 ± 0.70^{a}	6.60 ± 0.31^{a}	32.75 ± 2.10^{a}	54.52 ± 1.97^{a}	42.82 ± 1.93^{a}	42.65 ± 0.99^{c}

Mean (± SD, standard deviation) with the same superscript letter in a column are statistically the same in the duncan

Alanine Aminotransferase (ALT)

The Alanine Aminotransferase in the plasma of ***Chrysichthys nigrodigitatus*** was estimated with the lowest value recorded in July with 6.60 and the highest value recorded in June with 35.28. The Analysis of variance showed that there was a significant difference ($P < 0.05$). Further post-hoc analysis was carried out using the Duncan Multiple Range test (DMRT) which showed that there was no significant difference ($P > 0.05$) .

Alkaline Phosphatase (ALP)

The Alkaline Phosphatase in the plasma of ***Chrysichthys nigrodigitatus*** was estimated with the lowest value recorded in July with 32.75 and the highest value recorded in May with 113.34. The Analysis of variance showed that there was a significant difference ($P < 0.05$). Further post-hoc analysis was carried out using the Duncan Multiple Range test (DMRT) which showed that there was no significant difference ($P > 0.05$) .

Cholesterol

The Cholesterol in the plasma of ***Chrysichthys nigrodigitatus*** was estimated with the lowest value recorded in July with 54.52 and the highest value recorded in May with 106.98. The Analysis of variance showed that there was a significant difference ($P < 0.05$). Further post-hoc analysis was carried out using the Duncan Multiple Range test (DMRT) which showed that there was no significant difference ($P > 0.05$).

Glucose

The Glucose in the plasma of ***Chrysichthys nigrodigitatus*** was estimated with the lowest value recorded in July with 48.50 and the highest value recorded in June with 62.23. The Analysis of variance showed that there was a significant difference ($P < 0.05$). Further post-hoc analysis was carried out using the Duncan Multiple Range test (DMRT) which showed that there was no significant difference ($P > 0.05$) .

Total Protein (TP)

The Total Protein in the plasma of ***Chrysichthys nigrodigitatus*** was estimated with the lowest value recorded in June with 10.66 and the highest value recorded in July with 42.65. The Analysis of variance showed that there was a significant difference ($P < 0.05$). Further post-hoc analysis was carried out using the Duncan Multiple Range test (DMRT) which showed that there was no significant difference ($P > 0.05$) .

Discussion

The worldwide occurrence of residual pesticides, agricultural runoffs and forms of anthropogenic activity in aquatic environment makes it necessary to perform environmental risk assessment procedures to monitor the effects of contamination and

also pollution in fish and other aquatic organisms. Oxidative stress biomarkers and blood parameters are valuable tools in this regard (Romero-Ruiz *et al*., 2003; Li *et al*., 2010b). It was recorded that all the biochemical profile indicates that there is a significant difference ($P<0.05$) as observed throughout the entire months of the sampling and also observed in *chrysichthys nigrodigitatus*.

Biochemical profiles of blood can provide important information about the internal environment of the organism (Rehulka and Parova, 2000; Li *et al.*, 2010). Plasma enzymes, AST, ALT and LDH are frequently used to determine the toxic effects of various pollutants (Li *et al*., 2010). Increased release of ALT into the blood is indicative of damage to the integrity of hepatocyte membranes and the elevated AST activities are due to mitochondrial disruption as a consequence of heavy hepatitis (Qiu *et al*., 2009)

Marked elevations in plasma glucose concentrations may be due to increased demand for energy resulting in increased plasma catecholamines and corticosteroids(Samson *et al*., 2011) that are known to induce excessive secretion of adrenalin, which stimulate breakdown of glycogen to glucose by inhibiting the neuroeffector sites in adrenal medulla(Gupta, 1974). Such elevations may also be due to enhanced gluconeogenesis response of stressed fish in their attempt to satisfy their new energy demand (Winkaler *et al*., 2007). These findings agreed with the reports of Samson *et al.* (2011) but disagreed with the works of Omoniyi *et al.* (2002) and Ajani *et al.* (2007) who reported hypoglycaemia, respectively. Ajani *et al.* (2007) attributed the decrease in plasma glucose concentrations after an initial increase to progressive depletion of energy due to the fact that the initial increased mobilization could not overcome the immediate threat of the toxicity.The marked elevation of the glucose content in *Chrysichthys nigrodigitatus* were observed to more prominent.Moreover, a significantly higher glucose concentration was observed, which demonstrated the response of exposed fish to metabolic stress.

Conclusion

The observed changes in biochemical parameters of the fishes from the Bariga landing site showed that the Lagos lagoon is polluted and could result in an outbreak of disease within the residents around this region. The increase in alanine aminotranferase, alkaline phosphatase, aspartate aminotranferase in the plasma and changes in plasma glucose total protein, cholesterol concentrations are due to general adaptive response (biochemical response) to pollutant at the bariga landing site. However, the use of plasma is an important parameter in analyzing the functional ability of organism in the Lagos lagoon on direct contact with pollutant, thus it is highly susceptible to internal and external environmental fluctuations which helps to indicate changes in the quality of the environment.

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