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The Effect of Sublethal Concentrations of Paraquat on the Tissue Aminotransferases of the African Catfish: *Clarias gariepinus*

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Abstract: The aim of present study to determine the effect of sublethal concentration of paraquat on selected organs of African Catfish. The sublethal concentration of paraquat on the tissue aminotransferases of the African catfish (*Clarias gariepinus*) showed significance difference ($p<0.05$). Two concentration of paraquat (0.30 and 0.15 mg L^{-1}) where used for the exposure. The increase in the levels of determined tissue aminotransferases were directly proportional to the concentrations of paraquat and the exposure periods thus are dose and duration dependent. The protein metabolism as indicated by the levels of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) in the gill, kidney, muscle, liver, spleen, intestine and brain of the experimental fish (*Clarias gariepinus*) showed significantly increases ($p<0.05$) in their activities. Liver and kidney were the most affected organs while brain was the least affected.

Key words: Paraquat, tissues, aminotransferases, *Clarias gariepinus*, Nigeria

INTRODUCTION

Herbicides are commonly used as an economical effective method for the control of weeds and excessive vegetation; which has led to an increase in the number of herbicide developed for use and their subsequent introduction to the environment. Paraquat (1, 1-dimethyl-4, 4, dipyridinum) is often formulated as a dichloride salt or a dimethyl sulphate salt (Wagner, 1983). It is a quick acting, non selective herbicides, which destroy green plant tissue on contact and by translocation within the plant (Ecobichon, 1999).

Paraquat is common to be moderately toxic to many spouses of aquatic life in rainbow trout blue gill and channel catfish (NLM, 1992). Rainbow trout exposed to paraquat for 7 days, chemical test showed its presence in the gut, liver but not in the meat of fish (Stevens *et al*., 1991).

Biochemical characteristics of blood are among the important indices of the status of internal environment of the fish organism. Enzymes are biochemical macromolecules that control metabolic processes of organisms, thus a slight variation in enzyme activities would affect the organisms (Roy, 2002). Therefore, by estimating the enzyme activities in an organism, we can easily identify disturbances in its metabolism. Luskova *et al*. (2002) Das *et al*. (2004) and Humtsoe *et al*. (2007), had all reported the level of transferases in different organs of different fish exposed to toxicants. However, Akanji and Adesokan (2005), Yakubu *et al*. (2005) and Arise *et al*. (2005) also reported the effect of toxicant on transferases of rats.

In this study are determined the effect of sublethal concentrations of paraquat on selected organs (brain, liver, kidney, spleen, gill and muscles aminotransferases of the African catfish *Clarias gariepinus*.

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MATERIALS AND METHODS

Toxicant (paraquat-1, 1-dimethyl-4, 4-dipyridinum) formulated as dichloride salt was procured from an Agroallied store in the market (Warri, Delta State, Nigeria).

Juvenile of the *Clarias gariepinus* were procured from a privately owned fish farm in Sapele, Delta State, mean length and weight 3.10±0.24 cm and 19.38±1.25 g, respectively; which were transported in an oxygenated plastic bags and acclimatized in the laboratory (Research Laboratory, Department of Zoology, Delta State University, Abraka) for 14 days in 30 L plastic tanks. Fresh borehole water was used throughout the acclimatization and experimental period. Sixty juvenile of the African catfish *Clarias gariepinus* were used for the bioassay that lasted for 96 h. The fish where then divided into 3 sets into the various sublethal concentration of paraquat used 0.00 (control), 0.5 and 0.30 mg L^{-1} of paraquat concentration.

The water quality parameters of the fresh borehole water was monitored in accordance to APHA, (1989) is as shown in Table 1. The fish were fed twice daily (0800 and 1400 h) with commercial feed copens (2 mm) feed.

After the 96 h of exposure 15 fish was sacrificed for the analysis. They were dissected and the laboratory desired organs were removed, weighted, pounded with mortar and pestle after which homogenate was prepared before the serum was collected and analyzed and stored at 0 to 4°C for use.

Aspartate and alanine aminotransferase were determined with the use of the commercial diagnostic kits from the same manufacturer (Randox Laboratories Limited, UK).

The data obtained were subjected to two-ways Analysis of Variance (ANOVA) at 0.05 level of significance difference.

RESULTS

No mortalities were observed during the exposure period. There exist significant difference ($p<0.05$) in the aminotransferases determined. The mean values of AST and ALT of different organs determined in experimental fish exposed to sublethal concentrations of paraquat for 96 h are as shown in Table 2 and 3.

Table 1: Water quality parameters of borehole water used for the bioassay

Parameters	Values
Temperature (°C)	26.52 (0.03)
pH	6.88 (0.01)
Dissolved Oxygen (mg L^{-1})	6.94 (0.01)
Free Carbon (IV) Oxide (mg L^{-1})	4.32 (0.01)
Total Alkalinity (mg L^{-1})	12.22 (0.01)
NH_3 (Unionized) (mg L^{-1})	0.04 (0.02)

Standard Error in Parentheses

Table 2: Mean values of AST[#] obtained from various organs of catfish (*Clarias gariepinus*) exposed to sublethal concentrations of paraquat for 96 h

	Organs of *Clarias gariepinus*						
Concentration (mg L^{-1})	Gills	Kidney	Muscle	Liver	Spleen	Intestine	Brain
Control (0.00)	11.50	16.00	8.50	10.00	12.25	19.00	13.75
	(0.14)	(0.06)	(0.04)	(0.01)	(0.07)	(0.10)	(0.10)
0.15	17.00	37.50	13.75	44.50	26.00	27.75	15.75
	(0.10)	(0.11)	(0.08)	(0.04)	(0.10)	(0.12)	(0.10)
0.30	28.00	44.50	22.25	55.75	36.75	34.25	19.75
	(0.10)	(0.21)	(0.06)	(0.03)	(0.11)	(0.11)	(0.10)

[#] = Standard error in paraentheses obtained from 10 samples

Table 3: Mean values of ALT[#] obtained from various organs of catfish (*Clarias gariepinus*) exposed to sublethal concentrations of paraquat for 96 h

	Organs of *Clarias gariepinus*						
Concentration (mg L^{-1})	Gill	Kidney	Muscle	Liver	Spleen	Intestine	Brain
Control (0.00)	10.00	12.25	6.50	16.75	16.75	19.75	11.25
	(0.02)	(0.01)	(0.01)	(0.03)	(0.01)	(0.03)	(0.01)
0.15	28.75	43.75	27.00	49.25	36.25	38.5	15.50
	(0.04)	(0.06)	(0.04)	(0.12)	(0.03)	(0.10)	(0.03)
0.30	41.00	58.25	40.75	64.75	40.75	56.25	16.75
	(0.03)	(0.05)	(0.08)	(0.12)	(0.06)	(0.12)	(0.03)

[#] = Standard error in paraentheses obtained from 10 samples

The level of AST determined in the selected organs increase as the concentrations of paraquat concentration increased revealing liver > kidney > spleen > intestine > gill > muscle > brain order of AST in the fish.

However, the level of ALT determined in the selected organs also increased as the concentrations of paraquat concentration increased revealing liver > kidney > intestine > gill > muscle > spleen > brain order of ALT in the fish.

DISCUSSION

The result obtained revealed that the activities of ALT in selected organs is directly proportional to AST in the same organ.

The significant difference ($p<0.05$) in the activities of ALT and AST in experimental fish group compared to the control revealed that paraquat have caused damage in the parenchymatous tissue and skeletal musculature in the fish and probably must have disturbed the permeability and integrity of cell membranes as supported by Luskova *et al*. (2002) in the carp, *Cyprinus carpio* exposed to diazinon. David *et al*. (2004) reported significantly increase in activities of AST and ALT in cypermethrin-exposed fish thus indicating active transamination and oxidation deamination in the test organisms. Das *et al*. (2004) reported increase level of AST in serum, brain and fill of *Cirrhinus mrigala* (Hamilton) exposed to sublethal concentrations of ammonia. From the results obtained in the present study the changes in AST and ALT, were more pronounced in the liver and kidney than in other organs investigated. It was also observed that the magnitude of these changes also increased overtime in all the organs; which is in conformity with Suresh *et al*. (1991) and Reddy and Yellamma (1991) when both reported similar trend of ALT and AST levels in organs when *Cyprinus carprio* and *Tilapia mossambia* were exposed to sublethal concentrations of mercury and cypermethrin, respectively. Therefore, this study showed that changes in activities of these enzymes (ALT and AST) are both organ and concentration dependent indicating active transamination and thus protein metabolism.

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