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EFFECTS OF CYPERMETHRIN ON CONDITION FACTOR AND ORGANOSOMATIC INDICES OF *CLARIAS GARIEPINUS*

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ABSTRACT
The effect of sublethal exposure of Clarias gariepinus (mean length 29.47±1.88cm; mean weight 276.44±81.91g) to cypermethrin (0.00 – control, 0.05, 0.10, 0.20, and 0.25mlL^{-1}) for 10 days on the condition factor (k) and organosomatic indices such as Renatosomatic index (RSL), Hepatosomatic Index (HIS), Spleenosomatic Index (SSI) and Cardiosomotic (CSI). The results obtained from the study indicated no significant differences (P > 0.05) between the initial (K1) and final (K2) condition factor. In all the organosomatic indices used to assess response to stress in fish exposed to cypermethrin, significant increase (P<0.05) was observed in RSI, while the values of HIS decreased significantly when compared to the control after 10days. The values of SSI and CSI obtained during the trial were within the same range, as no significant changes was observed. Hence, in monitoring pollution of aquatic environment when administering cypermethrin, HIS and RSI will be a good biomarker of pollution effect on Clarias gariepinus.

Keywords: Pollution, Fish, Organosomatic-index, Cypermethrin, Sublethal concentrations.

INTRODUCTION

Clarias gariepinus belongs to the family clariidae which are air breathing non-scaly fresh water fish, valuable food of commercial importance (Marioghae, 1991). It has a wider distribution than any species in the clariids family (Ugwumba and Ugwumba, 2003). They have gained popularity in fish farming in Nigeria because they have high survival rate under culture conditions, readily accept artificial feeds and high flesh quality (Nwadukwe and Ayinla, 1993; Akinrotimi *et al.*, 2007). This fish species constitute a major catch of fisher folks particularly during the rainy season in most river in the southern part of the country (Moses, 1983).

The condition factor is an organism – level response, to factors such as nutritional status, pathogen effects and toxic chemical exposure, causing greater – than normal and less – than – normal weights (Andu and Kangor, 1996; Azmat *et al*., 2007). The condition factors are used as indicator of the well being of individual organism, because it integrates many levels of the organizational processes. For example, a decrease in condition factor is considered a reflection of depletion in energy reserves because these indices are positively related to muscle and livers energy content (Jones *et al*., 1999; Lizama *et al.*, 2002; Hasan and Seces, 2003).

Organosomatic indices can be described as the ratios of organs to body weight (Ronald and Bruce, 1990), measured organ in relation to body mass can be directly linked to toxic effects of chemical on target organ (Giullo and Hinton, 2008). It can also be used as indices of changes in nutritional and energy status (Maxwell and Dutta, 2005). Commonly used organosomatic indices in various stress related studies include hepatosomatic index (HIS), viscerosomatic index (VSI), spleenosomatic index (RSI) and Cardiosomatic index (CSI). Singh and Canario (2004) observed that hepatosomatic index is one of the most investigated biomarker due to important role of liver in detoxification of pollutants, while Dogan and Can (2011), observed that organosomatic index is an appropriate bioindicator for endocrine disruption in fish consequent of chemical exposure.

The current investigation was undertaken to understand the toxicity of sublethal cypermethrin concentration in *Clarias gariepinus*, by determining its effects on condition factor and organosomatic indices of this species.

MATERIALS AND METHOD

Experimental Fish and Acclimation

A total of 20 *Clarias gariepinus* (276.44±81.9g; 29.47±1.88cm) were obtained from a local commercial fish farm at Abuloma, Port Harcourt, Rivers State Nigeria. They were acclimated individually to laboratory conditions for a period of seven days in a plastic tank (20L) supplied with dechlorinated water (ground source). During the 7-day acclimation period and the experimental duration (10 days), the fish were fed once a day at 1% biomass with a commercial diet (35% crude protein). The water in the experimental tanks was renewed daily and the feed waste and excreta removed to maintain a clean environment. Before the exposure they were weighed using a sensitive weighing balance (H12-Satorius model, Portugal).

Experimental Procedure

Four fish per tank (0.2 x 0.4 x 0.2m^3) were exposed to grade levels (0.20, 0.40, 0.60, 0.80 and 1.00 mlL^{-1}) of cypermethrin and a control (0.00 m/L^{-1}) for 10 days with three replicates in each concentrations. At the end of the experiment the fish were carefully netted to minimize stress, and the fish weighed. After this, the fish were killed with a blow on the head and dissected. Then, the liver, kidney, spleen and the heart was carefully removed and weighed.

The organosomatic indices of the liver, heart, kidney and spleen were then calculated for the twenty fish according to Dogan and Can (2011) to get the organ weight to the body weight ratios of the fish as follows: $\frac{weight\ of\ the\ organ}{weight\ of\ the\ fish} \times 100$

The initial (K1) and final (K2) condition factor were calculated according to the method of Anderson *et al*. (1998)

Using the formula: $\mathrm{K} = \frac{W\ x100}{L^3}$

Where K= Condition factor ;W= Weight of the fish ;L=Length of the fish

During the exposure period which lasted for 10 days, some water quality parameters namely pH, conductivity, dissolved oxygen, alkalinity and hardness were taken daily using the methods described by APHA (1985).

RESULTS

The physicochemical parameters of water in the experimental tanks (Table 1) showed that there were no significant differences between the treatment and the control. Table 2 presents the condition factor and organosomatic indices of *C. gariepinus* following cypermethrin exposure. The changes between the initial (K1) and the final (K2) were not statistically significant (P > 0.05). The exposure of *C. gariepinus* to varying concentration of cypermethrin resulted in significant (P > 0.05) increase in RSI and decrease in HSI, when compared to the control values. However, no significant changes was observed in SSI and CSI, they were within the same range with the control value (Table 2).

Table 1: Physico-Chemical Parameters of Exposure Aquaria

Conc. Of cypermethrin. (ml/L)	pH	Conductivity µs/cm	Dissolved (Oxygen) m/gl	Alkalinity mg/l	Hardness Mg/1
0.00	5.46±0.23[a]	69.33±0.67[a]	7.82±0.07[a]	25.57±0.02[a]	6.61±0.01[a]
0.05	6.07±0.27[a]	69.75±0.75[a]	7.50±0.30[a]	24.48±0.28[a]	6.07±0.03[a]
0.10	5.89±0.39[a]	69.05±0.55[a]	7.22±0.53[a]	24.27±0.07[a]	6.29±0.02[a]
0.15	5.87±0.45[a]	70.15±0.55[a]	7.08±0.42[a]	24.16±0.41[a]	6.04±0.01[a]
0.20	6.15±0.37[a]	70.15±0.55[a]	7.04±0.11[a]	24.16±0.08[a]	6.28±0.23[a]
0.25	6.06±0.41[a]	69.80±0.56[a]	6.85±0.56[a]	24.77±0.58[a]	6.36±0.05[a]

Mean with different superscript in the same column are not significantly different ($P>0.05$)

Table 2: Condition factor and Organosomatic Indices of *Clarias gariepinus* exposed to chronic levels of cypermethrin for 10 days (Mean ± SD)

Conc. Of cypermethrin. (ppm)	Initial (K_1)	Final (K_2)	Renatosomatic	Hepatosomatic	Spleenosomatic	Cardiosomatic
0.00	5.45±0.45[a]	4.8±0.4[a]	2.85±0.15[a]	6.45±1.00[a]	0.45±0.10[a]	0.80±0.15[a]
0.05	4.80±0.25[a]	4.70±0.10[ab]	2.905±0.25[a]	6.65±1.50[a]	0.70±0.15[a]	0.85±0.10[a]
0.10	5.10±0.45[a]	4.20±0.25[a]	3.15±0.50[a]	7.00±1.00[a]	0.50±2.40[a]	0.45±0.10[a]
0.15	6.30±0.70[a]	5.10±0.45[a]	3.25±2.05[a]	6.20±0.35[a]	0.50±2.40[a]	0.85±0.10[a]
0.20	5.60±0.85[a]	4.75±0.70[a]	3.90±2.05[a]	4.40±0.85[a]	0.40±1.50[a]	0.75±0.10[a]
0.25	5.40±1.00[a]	4.80±0.95[a]	4.30±1.15[b]	4.35±0.10[ab]	0.50±0.30[a]	0.80±0.10[a]

Mean with different superscript in the same column are significantly different ($P<0.05$)

DISCUSSION

The various water quality parameters in this study did not vary significantly ($P < 0.05$) from those of the control. The range of pH, conductivity dissolved oxygen and total hardness were within the suggested tolerance ranges of the African catfish *C. gariepinus* (Ugwumba and Ugwumba, 2003). Katalay and Pariak (2004), observed that acute toxicity varies widely among fish species, depending on the concentrations of chemicals, age of fish, and exposure period. It is well known that fish have the ability to concentrate heavy metals, and different pollutants in their muscles, gills and different organs such as liver and kidney. Recently, Organosomatic indices and fish condition factor have been used to determine the sub lethal effects of these pollutants during the clinic diagnosis of fish physiology (Yi *et al.,* 2007; Ozer *et al.,* 2008; Mlamboo *et al.,* 2009).

The use of various organosomatic indices is based on the assumption that there is proportional relationship between fish size and the particular ratio in assessing fish stress by pollutant (Ronald and Bruce, 1990). In the organosomatic indices, there was slight decrease in weight of the liver as the concentration of cypemethrin increased to 0.25 mlL^{-1} A similar report was made by Instirtoris *et al.* (2001), when he observed a decrease in the weight of the liver, adrenals and kidneys of rats exposed to propoxur and heavy metals. Soufy *et al,* (2007) also reported reduced gonadosomatic and hepatosomatic indices when the fish *Oreochromis niloticus* was exposed to carbofuran. Decrease in the weight of liver suggests a decrease in the production of endoplasmic reticulum for protein systhesis in liver tissue under toxicant exposure (Bennet and Wolke, 2004). Liver reduction could also be as a result of decreased lipid storage. (Gabriel *et al.*, 2010).

The initial and final condition factor of *C. gariepinus* exposed to cypermethrin in this work, were within the same range, this result is in line with the report of Azmat *et al.* (2007) in *Johnius belangerii* exposed to fluoride but contradict that of Arellano *et al.* (1999) who exposed *Solea senegalensis* to cypermethrin pesticide and observed a decrease in condition factor which depicted a reduction in growth rate which may be due to a reduction in oxygen carrying protein levels and red blood cells, while increase occurred in the number of white blood cells. Anderson *et al*. (1998) also observed a decrease in condition factor when Indian shad was exposed to bleached kraft mill effluent. However, an increase condition factor was observed by Memaster *et al* (1991) in white sucker (*Astostomes commessomi*) and suggested a disruption in metabolic capability and altered energy allocation. The decease in condition factor may be due to the impairment of the olfactory systems which might have affected feeding, resulting in alterations of metabolic activities and energy allocation of the fish systems.

CONCLUSION

The indices measured in the present study is useful for monitoring the long-term effects of cypermethrin on fish. It can be concluded that cypermethrin is highly toxic to *C. gariepinus*. As the exposure to sublethal concentrations of cypermethrin resulted in significant organosomatic changes. These changes may be potentially disruptive for the survivability of *C. gariepinus* in the culture medium. This should be taken into consideration when this pesticide is used in agriculture fields very close to water bodies or aquaculture environment.

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