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ORIGINAL RESEARCH

Effects of Lambda cyhalothrin on some electrolytes and metabolites in organs of *Parpohiocephalus obscurus*

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ABSTRACT
The effect of Lambda cyhalothrin on some electrolytes and metabolites in some organs of *Parpohiocephalus obscurus* was investigated*.* The fish samples was purchased from private fish farm in Yenagoa metropolis and transported to the Department of Biological Sciences laboratory, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria where the study was conducted. The fish samples have mean weight and length of 42.20±0.1gSD and 16.50±0.12cmSD respectively. Various concentrations of the toxicants viz: 0.000, 0.012, 0.024 and 0.036ppm were made and the fish was exposed for 2 weeks in a renewal assay. At the end of the experiment, the fish were dissected and the muscle, kidney and liver obtained. The various parts were processed and analyzed using standard methods. The various parameters (viz: urea and creatinine in muscle and kidney and electrolytes including sodium in muscle and liver and only potassium in liver) showed significant variation (P<0.05) at various concentration of the toxicants. This is an indication of alteration of urea, creatinine, potassium and sodium of *Parpohiocephalus obscurus* exposed to Lambda cyhalothrin. In conclusion, electrolytes (sodium and potassium) and metabolites (urea and creatinine) are essential parameter in assessing toxicity of Lambda cyhalothrin in aquatic ecosystem.

KEY WORDS: *Aquatic ecosystem, Fisheries, Lambda cyhalothrin, Insecticides*

Introduction

Environmental pollution is mostly caused by anthropogenic activities and to lesser extent due natural effects. The degree of pollution depends on the prevailing effects. In recent times, the use of pesticides to control pest has increased. The type of pesticides used depends mainly on the target organisms. For instance, insecticides are used to control insects. Despite the useful nature of insects in agriculture such as pollination, they cause disturbance to human and its useful resources such as vegetation. Some of the insects are disease vectors such as mosquito (Ndiok et al., 2016, Bhattacharya *et al.,* 2014a,b).

Lambda cyhalothrin is a synthetic pyrethroid (an insecticide) used for the eradication of several insects at home and agricultural fields aphids, beetles, butterfly larvae, cockroaches, mosquitoes, ticks and flies (Mergel, 2010; He *et al*., 2008). According to Moretto (1991), Lambda-cyhalothrin is a pyrethroid that consists of a racemic mixture of two or more active of the four isomers of cyhalothrin. It is commonly mixed with buprofezin, pirimicarb, dimethoate or tetramethrin (http://www.awhhe.am/downloads/eu_project_presentations/chemicals_eng/lambda-cyhalothrin.pdf ,Accessed December 4th, 2016). Typically, Pyrethroids compound consist of two chemical families viz α-cyano (including deltamethrin, cypermethrin, λ-cyhalothrin and cyfluthrin) and no α-cyano group (including bifenthrin, permethrin, resmethrin).

Like other pesticides, Lambda cyhalothrin enters the soil through discharge of remains of materials used for packaging and storage and accidental discharge during spraying. It could enter aquatic ecosystem through runoff resulting from its use in agricultural field (De Moraes *et al*., 2013). Lambda cyhalothrin which is insoluble in water (Mergel, 2010) has some health implications. It is corrosive on the skin and eyes and it's characterized by tingling, pain and burning. Lambda cyhalothrin is toxic when ingested at moderate concentration. When inhaled it could lead to burning sensations, convulsions, coughing, labored breathing, shortness of breath, and sore throat (Mergel, 2010). Moretto (1991) have reported symptoms associated with spraying of lambda-cyhalothrin to include itching and burning of the face, nose or throat irritation with sneezing or coughing.

In animals, lambda-cyhalothrin caused alteration in metabolic and physiological processes. For instance, Fetoui *et al*. (2010) reported the toxic effects of lambda-cyhalothrin on the rat kidney. Fetoui *et al*. (2009) reported biochemical and histopathological changes in the liver of rats exposed to Lambda-cyhalothrin. Fetoui *et al*. (2008) also reported oxidative stress induced by lambda-cyhalothrin in rat erythrocytes and brain.

Fisheries have been widely used in toxicological studies of aquatic ecosystem. Changes in fish metabolic, physiological, pathological and behavioral response suggest stress condition. However, Lambda cyhalothrin is very toxic to fish (Mergel, 2010). Inyang *et al*. (2016a) reported that Lambda cyhalothrin elicit alteration in total protein and albumin in *Parpohiocephalus obscurus.* Other effects of ƛ-cyhalothrin in fisheries such as *Channa punctatus*, is neurotoxicant leading to alteration in acetyl cholinesterase (Kumar *et al*., 2009a), alterations in nucleic acids and protein contents (Kumar *et al*., 2008, 2009b), behavioral changes, skin colour, intense hyperactivity, enhanced loss of balance, rapid swimming, amplified surfacing activity, rate of opercular and convulsions (Kumar *et al*., 2011). Also De Moraes *et al*. (2013) have reported behavioral changes in *Brycon amazonicus* exposed to ƛ-cyhalothrin. Muthukumarave *et al*. (2013) reported that Lambda cyhalothrin induced biochemical and histological changes in the liver of *Oreochromis mossambicus.* Okechukwu and Auta (2007) reported the effect lambda-cyhalothrin on biochemical parameters (serum glucose, protein, cholesterol, triglyceride, glutamic pyruvic acid transaminase, glutamic oxaloacetic acid transaminase and alkaline phosphatase) of *Clarias gariepinus.* Ogueji and Ibrahim (2012) reported the effect of sub-lethal doses of Lambda-Cyhalothrin on Leukocyte sub-population (differential count) of African Catfish (*Clarias gariepinus*). As such this study assessed the effects of Lambda cyhalothrin on some electrolytes and metabolites in some organs of *Parpohiocephalus obscurus.*

Materials and Methods

Source of fish used in the experiment

The fish samples used for study were purchased from a private fish farm at Yenagoa, Bayelsa state, Nigeria. The fish sample was conveyed to the Department of Biological Sciences Laboratory, Niger Delta University in 50 liter plastic container with the pond water which was covered with net to avoid suffocation. Twenty eight (28) adult healthy *Parophiocephalus obscurus* (with mean weight 42.20±0.1gSD mean length 16.50±0.12cmSD) were acclimatized individually in a 40 litre circular aquaria for two weeks days (9.00-11.00h) with 35% crude protein diet at 1% biomass.

General bioassay technique

Sublethal concentrations of lambda cyhalothrin for the assay (0.012, 0.024, 0.36ppm) in addition to the control (0.000ppm) were determined based on the range finding test (Inyang, 2008). These were prepared by transferring 0.01, 0.02, 0.03mls with borehole water in the test aquaria. Furthermore, about 30L of the diluent water was used as control. Replicates of each treatment group were set up by introducing fishes individually into each aquarium. The exposure period lasted for 2 weeks during which the exposure media was renewed every 24 hours. The physio-chemical characterization of the water used for fish bioassay was carried out using standard methods previously described by APHA (1998) and the results obtained ranged from 25.00-25.13 ^{o}C (Temperature), 6.20-6.35 (pH), 12.44-17.88mg/l (alkalinity), 99.50-136.12 µs/cm (conductivity), 5.07 – 7.21mg/l (dissolve oxygen) and 0.23-0.50NTU (turbidity)

Determination electrolytes (sodium and potassium) and metabolites (urea and creatinine)

The various samples (muscle, kidney and liver) were obtained via dissection of the fishes. Thereafter approximately 0.5g of each sample was macerated with ceramic pestle and mortar and about 5ml of perchloric acid was added. The samples were centrifuged for 15 minutes at 3000rpm. The supernatant was transferred to EDTA bottle and was sent to Federal Medical Centre Yenagoa, Bayelsa state for analysis. Sodium and potassium were assayed using Logawary *et al* (2006) methods. Also urea and creatinine was also analyzed.

Statistical analysis

Statistical analysis was carried out using Statistical Package for Social Sciences software version 20. Data were expressed as mean ± standard error. One-way analysis of variance was carried out at P = 0.05 and Tukey Honestly Significance Difference statistics was used to determine the source of observed differences.

Results and Discussion

Table 1 presents the effects of liver and muscle electrolytes (sodium and potassium) of *Paraphiocephalus obscurus* exposed to Lambda cyhalothrin. In the muscle, the sodium concentration ranged from 56.00 (at 0.036ppm) to 104.67 mmol/L (at 0.000ppm). Basically, there was significance difference (P<0.05) among the various concentration of the toxicants. While potassium concentration in the muscle were not significantly different (P>0.05) among the various concentration ranging from 7.93 (at 0.036ppm) to 8.60 mmol/L (at 0.012 and 0.024ppm). In the liver the sodium and potassium concentration ranged from 50.67 (at 0.000ppm) to 68.50 mmol/L (at 0.024ppm) and 5.75 (at 0.012ppm) to 8.60 mmol/L (at 0.036ppm) respectively. There was significance difference (P<0.05) at various concentration. The variation in the electrolytes suggests the effect of the toxicant on the electrolytes. The trend reported in the electrolytes at various concentration is in accordance with the work of Ogamba *et al*. (2015a) in blood, liver and muscles of *Clarias gariepinus* exposed to 2, 4-Dichlorophenoxyacetic acid Ogamba *et al*. (2015b) in kidney and liver of *Clarias gariepinus* exposed to dimethyl 2, 2-dichlorovinyl phosphate; Inyang and Patani (2015) in plasma and organs of *Heterobranchus bidorsalis* exposed to rhonasate 360SL containing glyphosate; Inyang *et al*. (2016b) in kidney and liver of *Clarias gariepinus* exposed to fluazifop-p-butyl; Inyang *et al*. (2016c) in liver of *Heterobranchus bidosalis* exposed to glyphosate. The effect of the various pesticides on electrolytes of fisheries suggests stress resulting from the presence of the toxicant.

Typically, pyrethroids affect the permeability of the sodium voltage depending on channels in the nervous cells (De Moraes *et al*., 2013). The alteration of electrolytes could impede their roles. For instance, sodium and potassium are essential for the activity of many enzymes and have been implicated in the transport of Adenosine triphosphate which participates in several metabolic processes (Inyang and Patani, 2015; Inyang *et al*., 2016c). Like calcium, potassium and sodium ions help in the maintenance of normal irritability of the heart, muscles and nerves as well as selective permeability of cell membrane (Inyang and Patani, 2015). The significant variation (P<0.05) observed in the electrolytes may be associated with imbalances leading to elevated muscular activities and alterations in ionic fluxes across the muscle membrane (Inyang and Patani, 2015).

The effects of kidney and muscle metabolites (urea and creatinine) of *Paraphiocephalus obscurus* exposed to Lambda cyhalothrin is presented in Table 2. The urea content ranged from 0.80 (at 0.012ppm) to 1.80 g/l (at 0.036ppm) (muscle) and 0.25 (at 0.012ppm) to 0.50g/l (at 0.00ppm) (kidney). The creatinine content ranged from 163.00g/l (at 0.000ppm) to 361.50 g/l (at 0.012ppm) (muscle) and 4.00 (at 0.012ppm) to 31.33 (at 0.000ppm). Basically there was significance variation (P<0.05) for each of the parameters. The difference suggests stress due to the activities of the toxicants. The trend in the creatinine content in this study is comparable to the work of Inyang *et al*. (2016d) on gastro intestinal tract, muscle and liver of *Clarias lazera* exposed to dimethoate; Inyang and Thomas (2016) in blood of *Clarias gariepinus* exposed to sublethal levels of fluazifop-p-butyl. The fluctuation in the creatinine content in this study could be associated to stress due to the preset of toxicant. This could have affected the concentration of creatinine that catalyzes the conversion of creatinine to phosphocreatinine by splitting itself in the conversion of adenosine triphosphate (Inyang *et al*., 2016d). Creatinine and adenosine triphosphate are absolutely involved in the

Table 1: Effects of liver and muscle electrolytes of *Paraphiocephalus obscurus* exposed to Lambda cyhalothrin

Conc. of Lambda cyhalothrin, ppm	Muscle		Liver	
	Sodium, mmol/L	Potassium, mmol/L	Sodium, mmol/L	Potassium, mmol/L
0.000	104.67±3.52b	8.25±0.14a	50.67±0.60a	6.65±0.05b
0.012	67.00±3.61c	8.60±0.17a	51.33±4.81a	5.75±0.15a
0.024	78.00±4.16d	8.60±0.31a	68.50±0.87b	5.53±0.29a
0.036	56.00±3.06a	7.93±0.32a	68.00±1.65b	8.60±0.21c

Data were expressed as mean ± standard error: Different alphabets along the column indicate significance variation at P= 0.05 according to Tukey HSD statistics

Table 2: Effects of kidney and muscle metabolites (urea and creatinine) of *Paraphiocephalus obscurus* exposed to Lambda cyhalothrin

Conc. of Lambda cyhalothrin, ppm	Muscle		Kidney	
	Urea, g/l	Creatinine, g/l	Urea, g/l	Creatinine, g/l
0.000	1.07±0.12a	163.00±6.81a	0.50±0.03b	31.33±1.86c
0.012	0.80±0.10a	361.50±3.79c	0.15±0.02a	4.00±1.15a
0.024	1.25±0.15ab	204.50±3.06b	0.20±0.01a	10.50±1.44a
0.036	1.80±0.12b	221.33±10.73b	0.21±0.03a	22.00±2.52b

Data were expressed as mean ± standard error: Different alphabets along the column indicate significance variation at P= 0.05 according to Tukey HSD statistics

contractile process in the skeletal muscle mediated by the enzyme creatinine (Inyang and Thomas, 2016), hence alteration could affect the role of creatinine in fisheries.
Like creatinine, the significant difference (P<0.05) in urea content could be due to the effect of the toxicant. The trend of urea content in this study is comparable to the work of Inyang and Thomas (2016) in blood of *Clarias gariepinus* exposed to fluazifop-p-butyl. A significant (P<0.05) decline in urea concentration in the kidney suggests that the kidney be affected by the toxicant.

Conclusion

Insecticides are commonly used to eradicate insects in household and agricultural field. Pyrethroids based insecticides are mostly used. Lambda-cyhalothrin is major type of pyrethroids based insecticides. This study assessed the effect of lambda-cyhalothrin in electrolytes (i.e. sodium and potassium) and metabolites (i.e. urea and creatinine) in some organs of *Parpohiocephalus obscurus.* The findings showed that sodium content is altered in the muscle and liver while potassium is only altered in the liver. Furthermore, urea and creatinine are altered in the muscle and kidney. Hence, care should be taken during use of lambda-cyhalothrin based insecticides in eradicating insects in area close to surface water sources.

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