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Research Article

Effects of Lambda Cyhalothrin on Protein and Albumin Content in the Kidney and Liver of *Parpohiocephalus Obscurus*

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Abstract

This study evaluated the effect of Lambda cyhalothrin on protein and Albumin content in the kidney and liver of *Parpohiocephalus obscurus*. The fish (with mean weight 42.20 ± 0.1g SD mean length 16.50 ± 0.12 cm SD) samples used for the study 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. The fish samples were exposed to various concentrations of the toxicants (0.000, 0.012, 0.024 and 0.036 ppm) for 2 weeks. Thereafter, the kidney and liver of the fishes was obtained after dissecting. Both organs were processed and analyzed using standard metabolites methodology. The albumin and total protein showed significant variation ($P < 0.05$) at various concentration in most cases apart from albumin content in the liver. The study found that Lambda cyhalothrin elicit alteration in total protein and albumin in fisheries as such both parameters are useful indicator is determining toxicity in aquatic ecosystem.

Keywords: *Fisheries; Insecticides; Metabolites; Pesticides; Toxicity*

Introduction

Pesticides are material used to control pest. Pesticides are used for crop protection, control of disease causing organisms, prevention of insects transmitting diseases, preservation of food and other materials. During the application of pesticides on the target organisms, they pose public health risk especially to the sprayer. This is because pesticides are toxic to human, animals, plants and non-target organisms. When pesticides are applied into the environment to control a particular pests, they can miss their target and affect other organisms in the environment i.e. air, surface water and sediment, groundwater, soil. The biota in each of the environmental component (i.e. soil, water and air) could be affected depending on the type of pesticides, concentration and mode of application. Mostafalou and Abdollahi [1] reported that pesticides are one of the major factors associated with environmental contamination. When pesticides miss their target, they bioconcentrate in plants and kill some beneficial organisms in the ecosystem.

In biodiversity including humans, pesticides have the tendency to alter normal metabolism and physiology and under prolong exposure could cause death. Pesticides could cause poisoning, birth and neurological deformity, disruption of several systems including endocrine, nervous, cardiovascular, digestive, etc.

Typically, there are different types of pesticides and their use depends on the target pest. As such they can be classified according to pest they are used to eradicate i.e. insecticides, acaricides, herbicides, fungicides, rodenticides, fumigants. They can also be classified based on formulation (soluble in solvent especially, dust), origin (synthetic or organic) and mode of action (contact, systemic etc).

Pesticides may end up in surface water through runoff and affect aquatic organisms [2-5] such as zooplankton, phytoplankton, and fisheries abundance. Fish is a major source of animal protein especially in communities aligning water way in coastal region of the Niger Delta. Again, fisheries are obtained from their natural stock (wild) and pond. Irrespectively of the sources, they require water to thrive/survive. When pesticides enter the water, they induce metabolic, enzymatic, electrolytes, behavioral, physiological, histological, hematological and biochemical changes [2,3,6-9].

Insecticides containing pyrethroids are chemically classified into α-cyano group (deltamethrin, cypermethrin, λ-cyhalothrin and cyfluthrin); and no α-cyano group (bifenthrin, permethrin, resmethrin) [10]. Typically, pyrethroids based insecticides are used in agriculture to control biological vectors [10]. Pyrethroids are synthetic chemical compound analogues of pyrethrins, which are derived from the flowers of chrysanthemums (*Chrysanthemum cinerariaefolium*) [10,11]. Pyrethroids insecticides have the tendency to interrupt the normal functioning of the nervous system in an organism leading to paralysis or death. Pyrethroids based insecticides is a non-systemic and has contact and stomach action, and repellent properties [12].

Lambda-cyhalothrin is a synthetic pyrethroid insecticide used globally in agriculture, home pest control, foodstuff protection and control of disease causing vectors [13]. Pyrethroid pesticides are used preferably over organochlorines and organophosphates due to their high effectiveness, low toxicity to non-target organisms and biodegradability potentials [14]. Pyrethroids class of insecticides are usually regarded to be safe to human, however, there have been some instances of human fatalities [15]. Moretto [16] reported that spray man exposed to about 62g of lambda-cyhalothrin in about 2.7 – 5.1 hours per day do have itching and burning of the face, nose or throat irritation with sneezing or coughing.

Lambda-cyhalothrin can induce toxicity in mammals and well as fisheries. However, toxicity level tends to affect fisheries more compare to mammals. Fetoui., *et al.* [13] reported significant increase in kidney malondialdehyde and protein carbonyl levels and severe vacuolations, cells infiltration and widened tubular lumen in the kidney and decline in catalase activity, superoxide dismutase glutathione peroxidase, glutathione reductase and glutathione-S-transferase in rat exposed to lambda-cyhalothrin for 3 weeks. Fetoui., *et al.* [14] reported that lambda-cyhalothrin induces oxidative stress and modifies biochemical parameters and histological aspects of liver of male Wistar rats. Feboui., *et al.* [17] reported that lambda-cyhalothrin induce oxidative damage in tissues of Wistar rats. Velmurugan., *et al*. [18] reported histopathology in the gill, liver, intestine and kidney of *Cirrhinus mrigala* exposed to 0.3 ppb and 0.6 ppb of lambda-cyhalothrin for 10 days and reported that the gills were characterized by epithelial hyperplasia, aneurism, epithelial necrosis, desquamation, epithelial lifting, oedema, shortening of secondary lamellae and lamellar fusion; the kidney were characterized by necrosis of tubular epithelium, cloudy swelling of epithelial cells of renal tubules, narrowing of the tubular lumen, contraction of the glomerulus and expansion of space inside the Bowman's capsule; the intestine were characterized by intestinal lesions including infiltration of eosinophils into the lamina propria and atrophy of epithelial cells; and hepatic lesions in the exposed fish were characterized by hypertrophy of hepatocytes, cloudy degeneration, congestion, karyolysis, karyohexis, dilatation of sinusoids and focal necrosis.

Basically, Lambda Cyhalothrin [alpha-Cyano-3-phenoxybenzyl 3-(2-chloro- 3,3,3-trifluoropropenyl)-2,2-dimethylcyclopropanecarboxylate; which has 1:1 reaction mixture of the (Z)-(1R,3R), (S) ester and (Z)-(1S,3S), (R) ester] is one of the most active wide range pyrethroids sold in the market [19]. When they find their way to aquatic ecosystems via runoff, it could affect the fish composition and abundance. Kumar., *et al*. [19] reported that lambda cyhalothrin has neurotoxicant potential in *Channa punctatus*. Kumar., *et al.* [20] reported that lambda cyhalothrin can cause changes in behavior, skin colour, intense hyperactivity, enhanced loss of balance, rapid swimming, amplified surfacing activity, rate of opercular and convulsions activity in *Clarias batrachus*.

Therefore, this present study evaluates the effects of lambda-cyhalothrin in total protein and Albumin content in the kidney and liver 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 ± 0.1g SD mean length 16.50 ± 0.12 cm SD) were acclimatized individually in a 40 liter circular aquaria for two weeks days and fed between (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, 0.36 ppm) in addition to the control (0.000 ppm) were determined based on the range finding test [21]. These were prepared by transferring 0.01, 0.02, 0.03 mls with borehole water in the test aquaria. 30L of the diluent water was used as control. Replicates of each treatment level (concentration) and control 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 [22] and the following values were obtained: Temperature 25.00 - 25.13^{o}C, pH 6.20 - 6.35, alkalinity, 12.44 - 17.88 mg/l, conductivity 99.50 - 136.12 µs/cm, dissolve oxygen 5.07 – 7.21 mg/l and turbidity 0.23 - 0.50 NTU.

Total protein and Albumin determination

At the end of the 2-week experimental period, the fish was dissected and the kidney and liver was collected for total protein and albumin content analysis. About 0.5g of each organ (kidney and liver) was macerated with ceramic pestle and mortar and about 5 ml of perchloric acid was added. The samples were centrifuged for 15 minutes at 3000 rpm. The supernatant was transferred to EDTA bottle and was sent to Federal Medical Centre Yenagoa, Bayelsa state for analysis. Quantitate approach was used for the determination of total protein [23] and albumin [24].

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 $\alpha = 0.05$ and Tukey HSD statistics was used for multiple comparison.

Results and Discussion

The level of total protein and albumin in the kidney and liver of *Paraphiocephalus obscurus* exposed to Lambda cyhalothrin is presented in Table 1. In the kidney, the total protein was 0.000 g/l at 0.024 and 0.036 ppm of the toxicant and 0.50 g/l at 0.000 and 0.012 ppm of the toxicant. No significant difference ($P > 0.05$) existed between 0.000 ppm and 0.012 ppm and between 0.024 and 0.036 ppm. While in the liver, the level of total protein was 0.50 g/l at 0.000 and 0.012 ppm, 1.00 g/l at 0.024 ppm and 4.00 g/l at 0.36 ppm. Generally significant variation ($P < 0.05$) exist between the various concentration of the toxicant apart from 0.000 and 0.012 ppm. The total protein value in the liver is apparently higher than the values in the kidney. This could be associated to the role of the various organs in metabolism of toxicants. Total protein is an essential constitutes of cells and tissues which aid in the physiological functions of the cells [25,26]. Due to the fact that fish has low carbohydrates, protein which is architecture of the cell and main source of nitrogenous metabolism is used to enhance the energy demand [26]. The protein is the energy sources of spores during stress period [27]. The reduction of tissue protein-pesticides stress impacts in the conversion of tissue protein into soluble fraction [26].

Conc. of Lambda cyhalothrin, ppm	Kidney		Liver	
	Total protein, g/l	Albumin, g/l	Total protein, g/l	Albumin, g/l
0.000	0.50 ± 0.05b	141.00 ± 1.73d	0.50 ± 0.06a	0.00 ± 0.00a
0.012	0.50 ± 0.04b	95.10 ± 0.46c	0.50 ± 0.03a	0.00 ± 0.00a
0.024	0.00 ± 0.00a	73.50 ± 0.35b	1.00 ± 0.01b	0.00 ± 0.00a
0.036	0.00 ± 0.00a	53.70 ± 0.46a	4.00 ± 0.02c	0.00 ± 0.00a

Table 1: *Variation in Total protein and Albumin content in liver and kidney of Paraphiocephalus obscurus exposed to Lambda cyhalothrin. Data were expressed as mean ± standard error: Different alphabets along the column indicate significance variation at P = 0.05 according to Tukey HSD statistics.*

Albumin content ranged from 53.70 – 141.00 g/l in the kidney, being significantly different (P < 0.05) among the various concentrations of the toxicant. Also, the value declines as the concentration of the toxicant increases. The decline in values suggests that the toxicant have greatly influenced the normal functioning of the kidney. While in the kidney albumin content were 0.00 g/l among the various concentration of the toxicant. As such, the occurrence of albumin in the kidney could be associated with their role in metabolism.

Typically, total protein and albumin are some major metabolites in fisheries. The albumin aids in the transportation of protein for steroid hormones and fatty acids from adipose tissue to muscles [25,26]. The decline in albumin in kidney could be due to hindrance in transportation function of albumin [25,26]. Albumin is largely produced in the liver [28]. As such, the decline in albumin in the kidney as the concentration of the toxicant increases could be due to its immediate energy demand thus high synthesis occurs in the liver [28]. But this is contrary to the findings of this study in the liver, where albumin was not recorded. The lack of albumin in the liver may suggest that have been used up for other metabolic processes prior to the introduction of the toxicant.

The significance differences (P < 0.05) that exist in this study could be due to the fact that fish have poor ability to metabolize and eliminate pyrethroid oriented compounds [20]. As such, fish may be used as toxicity indicator of pyrethroid insecticides for vertebrates [20]. The alteration trend in this study is comparable to the work of previous works. Authors have reported significant variation in nucleic acids and proteins content of fisheries such as *Channa punctatus* [29], *Clarias batrachus* [30] exposed to lambda cyhalothrin. Alteration have been reported in protein content in muscle and liver of *Clarias lazera* exposed to dimethoate [31], total protein and albumin in blood of Clarias gariepinus exposed to sublethal levels of fluazifop-p-butyl [32].

Due to lipophilic nature, pyrethroids have a high absorption rate by gills of fish [20]. Fishes are highly sensitive to pyrethroids and the nervous system [10]. It also appears that fish lack enzyme system that hydrolyzes pyrethroids which are dependent on stereochemistry of the molecule [20]. The metabolites of fisheries are major indicator of pyrethroids toxicity in fisheries.

Conclusion

Pyrethroids pesticides are one of the commonly used insecticides in controlling insects that attack crops, causing diseases in plants, animals and humans. This study evaluated the effect of lambda-cyhalothrin in protein and Albumin content in the kidney and liver of *Parpohiocephalus obscurus*. The study found that the metabolites such as total protein and albumin could be affected. As such care, should be exercised in the use of lambda-cyhalothrin in the control of insects especially close to water bodies.

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