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Toxic-Effect of Aldrin and Copper Sulphate on Freshwater Prawn-*Caridina africana*

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Abstract: Two hundred rocky water prawns, *Caridina africana* were exposed to different concentrations of 0.0 g L^{-1}, 0.10 g L^{-1}, 0.15 g L^{-1}, 0.20 g L^{-1} and 0.25 g L^{-1}) of Copper sulphate and Aldrin solution. The median, lethal concentration (Lc50) for 96 h were determined and the behavioral pattern also. The 96-h Lc50 values were 0.15g L^{-1} for Copper Sulphate and 0.17 g L^{-1} for aldrin solution. The pesticide at varying concentration has significant effect on loss of reflex, increase hyperactivity, discoloration and hypereticulation. Logit and probit analysis showed no significant difference (<0.05) between the two toxicants.

Key words: Toxicity, aldrin, coppersulphate, prawn, lethal concentration, pesticides

INTRODUCTION

Prawns have been found to be of immense commercial value in Nigerian territorial water. They are found in most inland freshwater bodies including lakes, swamps, irrigation ditches, canals and ponds as well as in estuaries[1]. Serious efforts are being made to increase fish, prawn and crop production through intensive agricultural practices. This has resulted in a large-scale use of pesticides. Apart from domestic, industrial and agricultural wastes that are the major sources of water pollution. Pesticides are valuable tools in agriculture and forestry, but their involvement to the continuing degradation of the aquatic ecosystem cannot be disregarded. Majority of aquatic herbicides have undergone some toxicity testing to assess their effects on non-target aquatic organisms.

Pesticides usually get into the aquatic environment through runoff from treated land, spray drift during treatment, washing of spraying equipment in waterways or even from the air, through the control of aquatic weed and the control or the elimination of unwanted fish. Many aquatic organisms like prawns cultured fishes were killed in various parts of the world had been attributed to the indiscriminate use of pesticides in agriculture, when not used according to the manufacturer specification[2].

Aldrin and Copper sulphate are some of the commonly used pesticides on land or farm crops. They have also been used for the control of the spread of pest mainly in the cocoa producing area in Nigeria. Copper herbicides are normally used as algicides as many submerged higher plants are killed only at concentrations that also endanger aquatic life[3].

Wrong use of these pesticides and their dosages are wasteful both in terms of money and time, which may result in large number of aquatic animals dying.[2] Towards increasing the production and culturing of the freshwater prawn which are susceptible to chemicals and any little change in water quality, there is need to provide information on their response to some chemical toxicity being used in their area of location which affect their availability and seed production. Many authors had worked on toxicity effect of different toxicants on *Clarias gariepinus* and other freshwater cultured fishes[4-6].

This work focused on the determination of the median lethal concentration (LC50) of Aldrin and Copper sulphate on the survival of *C. africana.*

MATERIALS AND METHODS

Collection site and collection of prawn: Rocky freshwater prawns, *Caridina africana* were collected from Olumirin water pond in Erin-Ijesa using hand net. This is situated within Latitudes $7^0$30' and 8^0 45' Northeast. Two hundred *C. africana,* were randomly selected from the total prawns collected and kept in 80 liters circular container, 75% filled with oxygenated water and transported to the Limnology laboratory in the Department of Fisheries and Wildlife, Federal University of Technology, Akure. Prawns were held in the laboratory for ten days before the commencement of the experiment. They were fed a calculated ration of 35% protein using locally available food ingredients[7]. They were fed twice daily. The prawns were judged to be suitable for use in the study on the

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basis of no mortality, acceptance of food and apparent absence of diseases.

Toxicants experiments: Range finding test was conducted to determine the acute toxicity range for copper sulphate and aldrin for the prawn. This was done according to the standard methods/procedures[8]. Acute toxicity tests for 96 h were conducted based on range finding test results. Both the range finding test and the acute test each had one control and five tests in triplicates per toxicants. The acute test comprised one sub lethal toxicity test according to the standard method[8]. The range finding test lasted for 96 h with intervals of 6, 24, 48, 72 and 96 h. The experimental animals were weighed to the nearest 0.01g using a top loading balance (Mettler Toledo Pb 8401) and randomly distributed into 18 glass tanks (45× 60×40 cm) at 20 prawns per tank, filled with ten liters prepared varying concentration of the toxicant copper sulphate and prepared as follows: 0.10, 0.15, 0.20, 0.25 and 0.0 g L^{-1} (control). The same experiment was set up using the same procedures for Aldrin solution using varying concentration as copper sulphate above. The toxicant concentrations were prepared arithmetically and each concentration was in triplicate.

The experiment was conducted under standard static bioassay conditions[8], which brought about carefully controlled experimental conditions so as to define the response of the test organism to a particular toxicant.

Physio-chemical parameters: Temperature, pH and alkalinity levels of the control and other treatments were determined and the readings were taken at 24 h interval for a period of four days. The temperature was determined using the mercury-in-glass thermometer; pH was determined using a pH meter (Model 3015 Jenway) and alkalinity was determined by using conductivity meter PACM 35 model.

Biological data: Observations were made on changes in behaviour such as loss of balance, errastic movements, discoloration, air gulping and other external changes in the body of the prawns to the toxicants. Mortality in each container was determined.

Post toxicity analysis: At the end of the aute toxicity experiment, the dead and live animals were excised and their gills were removed. The histology of the gill was carried out to determine effect and extent of damaged of the toxicants Aldrin and Copper Sulphate on it.

Statistical analysis: The data obtained were analysed using logit and probit to test if there are significant difference between the concentration levels and time. Survival data were subjected to analysis of variance with an F test of significance (p = 0.05)

RESULTS AND DISCUSSION

The LC50 of copper sulphate on prawns was reached at low concentration of 0.15 mg L^{-1} (Table 1) There was no significant difference (p>0.05) between the replicates of the same treatment. *C. africana* showed variation in tolerance to the same lethal concentration of Aldrin in few treatments at a given period. The rate at which the prawns died varied proportionally with increasing level of concentrations. The LC50 of the Aldrin on the prawns was reached at 0.17 mg L^{-1} concentration, which killed half of the test organisms. The acute toxicity of copper sulphate and Aldrin decreased with increase in time. Fig. 1a and b showed the concentrations of copper sulphate and Aldrin and their effects on the mortality rate of *C. africana* for a period of 96 h. Total mortality occurred at concentration of 0.15 mg L^{-1} of $CuSO_4$ and 0.17 mg L^{-1} of Aldrin.

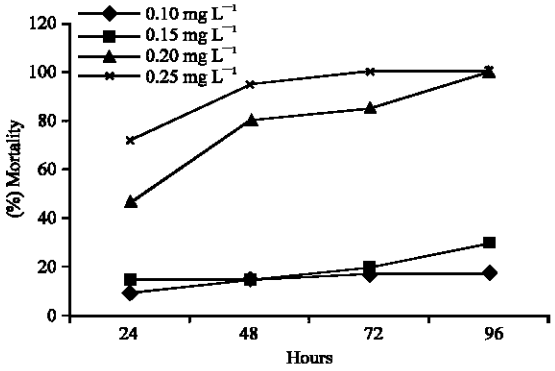

Fig. 1a: Acute test of Aldrin at different concentrations for C. Africana

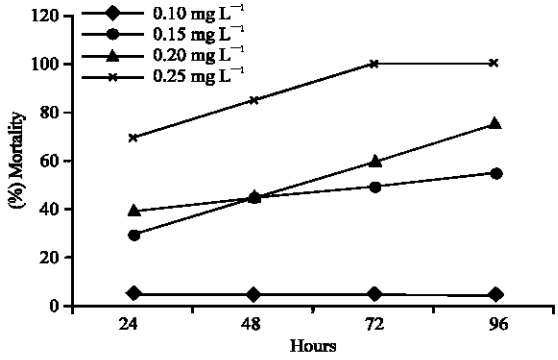

Fig. 1b: Acute test of cooper sulphate at different concentrations for C. Africana

Table 1a: The LC_{50} values of *C. africana* exposed to Aldrin and Copper sulphate

	Concentration (mg L^{-1})									
	Control		0.10		0.15		0.20		0.25	
Time	Aldrin	$CuSO_4$	Aldrin	$CuSO_4$	Aldrin	$CuSO_4$	Aldrin	$CuSO_4$	Aldrin	$CuSO_4$
24	--	--	10±0.03	5±0.01	15±0.04	30±0.03	75±0.04	40±0.01	95±0.01	70±0.02
48	--	--	15±0.02	5±0.01	15±0.01	45±0.03	80±0.04	55±0.01	95±0.01	85±0.03
72	--	--	17.5±0.02	5±0.02	20±0.03	50±0.02	85±0.02	60±0.02	100±0.01	100±0.01
96	--	--	17.5±0.03	5±0.01	30±0.03	55±0.04	90±0.04	75±0.01	100±0.02	100±0.02

Table 1b: LC50 value of Toxicants to *C. Africana*

Time (h)	$CuSO_4$ Concentration (mg L^{-1})	Aldrin Concentration (mg L^{-1})
24	0.25	0.20
48	0.20	0.20
72	0.15	0.15
96	0.15	0.15

Table 2: Environmental physico-chemical parameters in the acute toxicants treatments of the prawn

		Concentration (mg L^{-1})									
		Control 0.0 g L^{-1}		0.10 g L^{-1}		0.15 g L^{-1}		0.20 g L^{-1}		0.25 g L^{-1}	
Time (h)	Parameters	Aldrin	$CuSo_4$	Aldrin	$CuSo_4$	Aldrin	$CuSo_4$	Aldrin	$CuSo_4$	Aldrin	$CuSo_4$
24 h	Temp (°C)	28.00±.14	28.00±0.14	28.00±.14	28.00±.14	28.00±.14	28.00±.14	28.00±.14	28.00±.14	28.00±.14	28.00±.14
	pH	7.26±0.56	7.26±0.67	7.49±0.75	7.50±0.87	7.50±0.19	7.50±0.68	7.60±0.66	7.60±3.12	7.60±0.65	7.60±0.45
	Alkalinity (mg L^{-1})	79.00±3.13	79.00±0.28	82.00±2.41	82.00±1.87	82.00±2.26	82.00±1.67	85.00±4.08	85.00±2.44	85.00±3.60	85.00±3.5
48 h	Temp (°C)	27.50±0.25	27.50±0.56	28.00±.14	28.00±.14	28.00±.14	28.00±.14	28.00±.14	28.00±.14	28.00±.14	28.00±.14
	pH	7.20±0.01	7.20±0.60	7.30±1.33	7.30±0.09	7.30±1.20	7.30±0.01	7.30±0.90	7.30±0.1	7.40±0.76	7.40±0.12
	Alkalinity (mg L^{-1})	79.00±2.20	79.00±0.66	83.00±3.43	83.00±3.40	83.00±2.07	83.00±2.36	84.00±4.35	85.00±3.49	85.00±4.53	85.00±3,97
72 h	Temp (°C)	27.00±1.99	27.00±2.09	28.00±1.80	28.00±2.03	28.00±1.20	28.00±1.98	28.00±1.29	28.00±2.07	28.00±2.91	28.00±3.22
	pH	7.20±0.22	7.20±0.59	7.30±0.34	7.30±0.61	7.30±0.40	7.30±1.21	7.30±0.98	7.30±1.02	7.40±0.47	7.40±1.22
	Alkalinity (mg L^{-1})	79.00±0.04	79.00±0.45	85.00±3.20	85.00±3.70	85.70±2.67	86.00±3.40	87.00±2.45	87.00±2.89	87.50±3.42	87.90±3.05
96h	Temp (°C)	27.00±2.54	27.00±2.99	28.00±3.66	28.00±1.90	28.00±0.45	28.00±2.01	28.00±2.35	28.00±2.76	28.10±2.56	28.30±1.97
	pH	7.20±0.45	7.20±0.67	7.30±1.23	7.33±0.98	7.30±1.05	7.34±2.05	7.35±0.45	7.34±0.76	8.40±0.45	8.40±1.95
	Alkalinity (mg L^{-1})	79.50±	79.50±	86.00±2.78	85.00±2.10	86.00±0.78	87.90±3.06	87.98±4.01	87.90±2.95	89.40±2.67	89.89±4.37

The physio-chemical parameters results obtained from the test solutions for the period of 96 h showed that the values were close to the physio-chemical parameters of the control (Table 2). Copper sulphate and Aldrin has negligible or no effect on the temperature, pH, alkalinity of a given volume of water. The toxic form of copper is the cupric ion Cu^{2+}. Copper sulphate dissociates in water to give Cu^{2+}, which then forms oxide and hydroxycarbonate precipitates and soluble hydroxyl and carbonate. The result obtained before the test were found closed to the physico-chemical parameters of the control. The result in this work differed from the work carried out on the lethal effect of the detergent[9], (Elephant blue [R] on the Nile Tilapia *Oreochromis niloticus* and reported 96 hour LC50 of 9.77 mg L^{-1}. They reported that increased water quality, dissolved oxygen increases from 6.50 mg L^{-1} to 8.30 mg L^{-1} in tank containing 120 mg L^{-1} detergent, pH shift slightly from 6.30 to the alkaline death point of 10.75.

The additions of any herbicides to a plant or crop affect the body of the water, definitely alter the water quality. The physio-chemical factors influence vertical and horizontal migration of organisms, their distribution and feeding regime. A rise in temperature lowers the period of survival of the prawns, their activities, behaviour, feeding, growth and even reproduction[3].

Observations from the tests using Copper sulphate and Aldrin as toxicants on the prawns were presented in Table 3: Immediately the prawns were introduced into the various treatments, they showed initial disturbed swimming movement, rapid carapace movements and piping at the surface. This was followed by blackening of the whole body, unusual lethargy and tendency of the prawns to settle at the bottom, motionless with slow carapace movement. This is an indication of stress or weakness, similar observation was also observed[10]. Lower level of the toxicant did not produce obvious changes in the prawn behavior. Abnormal behavior of

Table 3: Behavioural patterns of *C. africana* to CuSO4 and Aldrin toxicants at different concentrations.

	Concentrations (mg L^{-1})																		
	24 h									48 h									
	0.0	0.10		0.15		0.20		0.25		0.0	0.10		0.15		0.20		0.25		
Parameters	control	Aldrin	$CuSO_4$	Aldrin		$CuSO_4$	Aldrin	$CuSO_4$	$CuSO_4$	Aldrin	control	Aldrin	$CuSO_4$		Aldrin	$CuSO_4$		$CuSO_4$	
	Aldrin	$CuSO_4$																	
Loss of reflect	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	+	+	+	
Erratic swimming	-	-	-	-	-	-	+	+	+	-	-	-	-	-	+	+	+	+	
Discol-uration	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	+	+	+	
Change in behaviour	-	-	-	-	-	-	+	+	+	-	-	-	-	-	+	+	+	+	
Molting	-	-	-	-	-	-	+	+	+	-	-	-	-	-	+	+	+	+	
Death	-	-	-	-	-	-	+	+	+	-	-	-	-	-	+	+	+	+	
	78 h									96 h									
Loss of reflect	-	-	-	-	-	+	+	+	+	-	-	-	-	-	+	+	+	+	
Erratic swimming	-	-	-	-	-	+	+	+	+	-	-	-	-	-	+	+	+	+	
Discol-uration	-	-	-	-	-	+	+	+	+	-	-	-	-	-	+	+	+	+	
Change in behaviour	-	-	-	-	-	+	+	+	+	-	-	-	+	+	+	+	+	+	
Molting	-	-	-	-	-	+	+	+	+	-	-	-	+	+	+	+	+	+	
Death	-	-		-	-	+	+	+	+	-	-	-	+	+	+	+	+	+	

the prawns to the copper sulphate and aldrin increased with increasing level of toxicant and also decreased with the time exposure. The prawns showed increased hyper activities immediately they were exposed to different concentrations of Aldrin. This activity was exemplified by their exhibition of swerving movement and gasping. Prawns showed variation in tolerance to the same lethal concentration of copper sulphate in some treatments at a given period Fig. 1a and 1b. This is an indication of physiological stress/poisoning in the prawns exposed to sub-lethal concentration of toxicants. It was discovered that metabolic rate decreased with increasing concentration of pesticide as observed[11] that the feeding rate of the fish decreases with increasing concentration of pesticides. Thus indicating that there were active ingredients in the pesticides, which act as metabolic stressors. It was reported that textile with waste water and detergent wash caused the hermit crab *Clibinarius africanus* to crawl all directions, with high concentration 10 mg L^{-1} causing the crabs to climb on each other in a way suggestive of an avoidance reaction[12].

Hyperplasia was generally more pronounced towards the distal tip of the filament. This hyperplasia resulted in fusions of many lamella markedly reducing the respiratory surface area of some filament. Gill of *C. africana* exposed to Aldrin showed varying degrees of damage. The prawns showed separation of respiratory epithelium from underlying supporting tissue. Hyperplastic and club-shaped lamella were seen in the lamellae of the exposed, *C. africana.* This agreed with similar work that reduction in fish respiration is mainly due to mucus coagulation in the gills which was caused by high pH to which *Cyprinus carpio* larvae subjected to, led to lowered oxygen consumption of the carp fry at high pH[13]. Similar observation was also made on trout exposed to acute and chronic levels of pH.

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