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TOXICITY EFFECTS OF COPPER IONS CONCENTRATIONS ON CRAYFISH

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ABSTRACT

Forty-nine fingerlings crayfish were collected from Ogunmola fish Breed, Oyo. After the crayfish had been acclimatized in the laboratory for a week, seven each were introduced into the different concentrations of copper sulphate solution that had been prepared. A control, that contained 0.00mg/L of copper sulphate was made. These set-ups were studied and observed at different intervals of thirty minutes, one, two, four and twenty-four hours, two, three and four days. Chi-square statistical method was used for the data analysis. It was observed that the rate of mortality increased with increase in the concentration of the toxicant (copper sulphate solution). Conclusively, the environmental sample was polluted with more than lethal concentrations of copper sulphate solution, that was why the crayfish went into extinction. These recommendations were made: that the water bodies should not be sprayed with algaecides, fungicides and pesticides, chemicals should not be used to kill aquatic organisms, and that the environment should be monitored to ascertain its pollution.

INTRODUCTION

A variety of toxic substances are discharged into the environment where they may exert harmful effects on organisms vowel and Connell (1980). Toxic substances have two important aspects to their actions. Firstly, the physiological impact of the substance on the organisms and secondly the concentration in the environment or dose administered to the organism which causes that effect. The concept of toxicity includes the basic principle that harmful effects are related to dose or concentration and below a certain minimum, there will be no harmful effects. In toxicity test generally, two sorts of bioassay are identified. One is the chronic, sub-lethal test, which examines responses in essential life processes such as growth, reproduction and changes in blood composition (Hodgson and Guthrie 1980). The other, which this paper focused on, is the acute-lethality test, where the measure response

is death.

In the natural aquatic environment there is a bi-accumulation and bi-concentration of heavy metals such as copper, lead, mercury and zinc in the sediment, which later form food for aquatic organisms (Opasina and Oyewole 2000).

STATEMENT OF THE PROBLEM

Environmental samples such as water, aquatic organisms, sediment, land and air have been faced with problems ranging from pollution, incessant burning and application of chemicals. The animal under study is not an exception to all these problems

PURPOSE OF THE STUDY

The purpose of this study was to ascertain the toxicity effects of copper ion concentrations on crayfish and to make adequate recommendations to prevent future environmental pollution by certain metals.

RESEARCH HYPOTHESIS

That the rate of toxicity increases as the concentrations of the toxicant increase.

That mortality rate increases as the concentration of toxicant increases.

MATERIALS AND METHOD

Forty-nine fingerlings crayfish were collected by dip net from a local fish pond (B.K. Ogunmola fish pond along Unique Hotel road, Mobolaje Area Oyo). The crayfish were of the same size and sex. The crayfish were acclimatized to the water that was metal/ion free and not fed for a day before the test was carried out. A preliminary assay was conducted to determine the order of magnitude of copper concentration that is toxic to the crayfish. Seven five liter jars were cleaned and rinsed thoroughly, filled with water and copper sulphate solution added to make the following concentrations: 0.00, 50.00, 100.00, 150.00, 200.00, 250.00 and 300.00mg/L. The zero copper served as a control. Each jar was stocked with seven crayfish of the same size and sex; care was taken not to injure them in the process. The assay was run for four days at these intervals: thirty minutes one hour, two, four and twenty-four hours, two, three and four days (Timbrell 1982). Each crayfish was removed as soon as it was noticed dead, when no movement or respiration was observed.

DATA ANALYSIS AND RESULTS

The data collected from the test were put into tables for statistical computation and analysis. Chi-square statistical method was used to arrive at certain information about toxicity effects of copper ions concentration son the crayfish.

Table One: Crayfish Mortality Data

Copper Concentration	**Number of tests animals**							
	Surviving after							
Mg/l	30mins	1	2	4	24hrs	2	3	4Days
300.00	6	4	2	0	0	0	0	0
250.00	6	4	3	2	1	0	0	0
200.00	7	5	3	2	1	0	0	0
150.00	7	6	4	3	2	1	0	0
100.00	7	6	5	4	3	2	0	0
50.00	7	7	6	5	3	2	1	0
0.00	7	7	7	7	7	7	7	7

Table Two: Table of observed frequency (Oij)

Copper Concentration in mg/L

TIME	0.00	50.00	100.00	150.00	200.00	250.00	300.00	TOTAL
30 MINS	7	7	7	7	7	6	6	47
I HOUR	7	7	6	6	5	4	4	39
2 HOURS	7	6	5	4	3	3	2	30
4 HOURS	7	5	4	3	2	2	0	23
24 HOURS	7	3	3	2	1	1	0	17
2 DAYS	7	2	2	1	1	1	0	12
3 DAYS	7	1	0	0	0	0	0	08
4 DAYS	7	0	0	0	0	0	0	07
TOTAL	**56**	**31**	**27**	**23**	**18**	**16**	**12**	**183**

Key: (Oij) - This is the summation of the horizontal rows and vertical rows. The total summation for all the horizontal rows and vertical rows columns tally and is equal to 183.

Table Three: Table of expected frequency (Eij)

Copper Concentration in mg/L

TIME	0.00	50.00	100.00	150.00	200.00	250.00	300.00	TOTAL
30 MINS	14.38	7.96	6.93	5.91	4.62	4.11	3.08	46.99
I HOUR	11.93	6.61	5.75	4.90	3.84	3.41	2.56	39.00
2 HOURS	9.18	5.08	4.43	3.77	2.95	2.62	1.97	30.00
4 HOURS	7.04	3.90	3.39	2.89	2.26	2.01	1.51	23.00
24 HOURS	5.20	2.88	2.51	2.14	1.67	1.49	1.11	17.00

2 DAYS	3.67	2.03	1.77	1.57	1.18	1.05	0.79	12.00
3 DAYS	2.45	1.36	1.18	1.01	0.79	0.70	0.52	8.01
4 DAYS	2.14	1.19	1.03	0.88	0.69	0.61	0.46	7.00
TOTAL	**55.99**	**31.01**	**26.99**	**23.01**	**18.00**	**16.00**	**12.00**	**183**

Key: (Eij) - This was obtained from table two when vertical summation was multiplied by each horizontal row summation and divided by total number of one hundred and eighty-three.

DISCUSSION:

From table one, at thirty minutes one test organism each died when the concentrations were 250.00 and 300.00mg/l respectively, leaving six organisms surviving. None was dead at concentrations zero, 50.00, 100.00, 150.00 and 200.00mg/L respectively. At one hour, three test organisms died when the concentrations were 250.00 and 300.00mg/L respectively, while two died when the concentration was 200.00mg/L. One each died when the concentrations were 100.00 and 150.00mg/l respectively. At two hours, five test organisms had died leaving only two surviving when the concentration was 300mg/L, while four died when the concentration was 200 and 250.00mg/L respectively. Three organisms died when the concentration was 150.00mg/L. Two died leaving five behind when the concentration was 100mg/L while one died when the concentration was 50.00mg/L.

At four hours, no organism survived at 300.00mg/L concentration, while only two survived at 200 and 250.00mg/L concentration. Two, three and four died at concentrations 50.00, 100.00 and 150.00mg/L. At twenty-four hours, four test organisms died leaving three, when the concentrations were 50.00, and 100.00mg/L respectively while five died when the concentration was 150.00mg/L. Six died when the concentrations were 200.00and 250. 00mg/L respectively while none survived when the concentration was 300.00. Second day, five test organisms died when the concentrations were 50.00 and 100. 00mg/L leaving only two surviving at 150. 00mg/L concentration, six test organisms died, while at 200, 250.00 and 300. 00mg/L concentrations, none of the test organism survived.

Third day, only one test organism survived at 50.00mg/L concentration. None survived at other concentrations. Fourth day, none of the organisms survived. No organism died at the zero concentration of copper sulphate solution because it served as a control.

From table two above, the horizontal rows data were summed and the summation for each row was

47, 39, 30, 23, 17, 12, 8, and 7 respectively. The vertical rows data were also summed and the summation for each was 56, 31, 27, 23, 18, 16 and 12 respectively. The total summation for all horizontal rows and vertical rows columns tally and is equal to 183. In order to obtain the expected frequency (Eij), the data from table two was used. Each vertical summation was multiplied by each horizontal row summation, the result obtained was divided by one hundred and eighty-three (183).

$$(Eij) = \frac{56 \times 47}{183} \quad \frac{56 \times 39}{180} \quad \frac{56 \times 30}{183} \quad \ldots\ldots\ldots \quad \frac{12 \times 7}{183}$$

(Eij) = 14.38 11.93 9.18 0.46

From table three, at thirty minutes, the expected value for the first vertical column was 14.38, when the concentration was zero while it was 7.96 at concentration 50.00, it was 6.93 at concentration 100.00mg/L, while it was 5.91 at concentration 150mg/L. At concentration 200.00mg/L, it was 4.62, while at concentration 250mg/L it was 4.11 while at concentration 300. 00mg.L it was 3.08. The horizontal rows data were summed up and the summation for each horizontal row was 46.99, 39.00, 30.00, 23.00, 17.00, 12.00, 8.01 and 7.00 respectively. The vertical rows data were also summed up and the summation for each row was 55.99, 31.01, 26.99, 23.01, 18.00, 16.00, 12.00 respectively. The total summation for all the horizontal rows and vertical rows also tallied and was equal to one hundred and eighty-three (183).

From tables two and three.

$$\text{Chi-square } (x^2) = \frac{(Oij - Eij)^2}{Eij}$$

$$= \frac{\text{(observed frequency - Expected frequency)}}{\text{Expected Frequency}}$$

$$\text{Chi - Squere } (x^2) = \frac{(7 - 14.38)2}{14.38} + \frac{(7 - 7.96)2}{7.96} + \frac{(7 - 6.93)2}{6.93}$$

Chi Square (x2) = 3.79 + 0.12 + 0.0007

Chi square calculated =52.5119

At 5% level of significance and at 45 degree of freedom, the chi - square (x2) critical (i.e. from the table is 61.6560). Since chi-square calculated was less that chi-square (x2) critical value, the hypothesis formulated which “States that the rate of toxicity increases as the concentrations of the toxicant increase, and that the mortality rate increases as the concentration of the toxicant increases, then the hypothesis was accepted.

CONCLUSION

In conclusion, the environmental sample under studied was contaminated and concentrated by copper sulphate solution. This adversely affected and led to the death of the organism under study.

RECOMMENDATIONS

To prevent toxicity and concentration of the natural environmental samples, such as surface water, sediment, aquatic plants and animals with toxic substances, the following recommendations were made:

1. That the water bodies should not be sprayed with algaecides, fungicides and pesticides.
2. That containers from factories or industries should not be dumped into water bodies, as this was injurious to the aquatic organisms.
3. That chemicals should not be used to kill aquatic organisms.
4. That the environment should be monitored to ascertain its level of pollution.
5. That routine analysis or examination be carried out to determine the level of toxic pollutants in the environment periodically.

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