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Original article

EFFECTS OF COPPER AND LEAD ON GROWTH, FEEDING AND MORTALITY OF TERRESTRIAL GASTROPOD *LIMICOLARIA FLAMMEA* (MULLER, 1774)

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The effects of different concentration of copper and lead on feeding and growth response of Limicolaria flammea were studied. Low dose (1mg) of copper does not affect feeding activity in Limicolaria flammea whereas concentrations of 5mg and 6mg evoked a slow feeding rate. At low metal dosages there was no clear relationship between the deaths recorded in correlation with metal dosages, but at high Lead dosages there was a significant correlation between metal dosages, length of exposure and number of mortalities recorded (0.965; p < 0.01).

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INTRODUCTION

Limicolaria flammea is very common during the rainy season in the Western part of Nigeria and the meat constitutes an important part in the diet of most villagers especially in the rural areas of this region.

Limicolaria flammea are herbivores and feed on leaves of pawpaw (*Carica papaya)*, water leaf (*Talinum triangulare*), as well as dead and rotting leaves (Ajayi *et. al.* 1978; Marigomez and Sacz 1985 and Egonmwan, 1988). However they do feed on grains for example guinea corn, (Amusan, 1990) and other vegetables which man also use as food but do not cause any significant damage. *Limicolaria flammea* is edible and economically important especially in the rural areas of Nigeria and the shells are used for decoration and ornamentation,

Aureshi, (1980) carried out work on the acute toxicity of heavy metals to fish food organisms, the acute toxicity of Copper, Mercury, Cadmium, Zinc and Lead to the fish food organisms. Water flea Daphinia spp. and the Ostracod Cypros spp. was determined by static bioassay experiments. It was observed that the individual toxicity of heavy metals were in the order Mercury> Cadmium> Zinc> Lead> Copper.

Molluscs had earlier been used as indicator of heavy metal pollution Nuenberg, (1984) studied fresh water molluscs as accumulation indicator for monitoring heavy metal pollution and observed that the metals tested did not concentrate in a specific tissue of the animals examined.

Also, Beaby and Eaves (1983) observes that molluscs can accumulate higher concentrations of metal ions than other groups of invertebrates. The incidence of abnormal environment al concentrations of metal affects numerous phenomena involved in the development and maintenance of molluscan populations such as feeding, growth, reproduction, general physiological activity and maturity (Bonelly.De Calvenli, 1958 and Calabrese *et. al*; 1977).

Fertilizers are the main sources of copper as well as zinc and mercury pollution (Simkiss, 1984) Corp Morgan, 1991; Sporgeon *et. al;* 1994, LenaxRao,1997). These actions are also discharged with industrial wastes and from pesticides and herbicides (Morgan & Mogan, 1988, and Frans *et. al;* 1997).

Lead pollution occurs as a consequence of combustion of petrol additives in automobiles and reaches soil by means of atmospheric precipitation. It could also get to soil by means of atmospheric precipitation. It could also get to soil from effluents discharged from industries using lead e.g. Batteries Manufacturing Industries. The chemicals get into snails when they feed on vegetation, the accumulation of these chemicals can therefore have an effect on *Limicolaria flammea* since these animals are non target organisms and are of economic importance there is need to protect their population. Therefore, this study aims to examine the effects of different concentration of copper and lead on feeding and growth response of *Limicolaria flammea.*

MATERIALS AND METHOD:

Snails: Snails were collected from three sites in the University of Lagos; Nigeria. *Limicolaria flammea* were abundant during the rainy season in the farmlands within the University. Collections were made any time the specimens were needed to avoid the snails being traumatized. Collected specimens were then acclimatized in the laboratory for six days prior to start of the experiment to minimize physiological differences (Marigomez *et. al,* 1985).

Bioassay: The metals tested were lead (Pb) from Lead acetate and Copper (Cu) from copper sulphate. Guinea Corn was ground, moistened with water and weighed, rolled into pellets, placed inside sterilized petri dishes and dried in an oven maintained at 80^{o}C for two hours, the food item was removed, weighed kin to 5g each and distributed into petri dishes. The food materials were then treated with metal concentrations of 1mg, 2mg, 3mg, 4mg, 5mg, and 6mg, and then weighted. Snails measuring between 3.0cm and 5.0cm in length and weighing between 4.0g and 5.0g were then selected. Twenty each were placed in seven plastic boxes and kept in the laboratory maintained at temperature of 240^{0}C. Animals were kept moist by sprinkling with water everyday. Animals weight were measured everyday by these of an electric balance. An individual was removed from each box for histological analysis every 3 days. Mortality was recorded by examining the animal's everyday starting from the second day of bioassay for 21 days. The experiment was replicated twice for each metal.

RESULTS

Feeding Activities: The amount of food eaten by snail when treated with copper sulphate increased from 2.00 $\pm$ 1.10g on the 3rd bioassay day to 14.40±1.2g on the 21st bioassay day using metal concentrations 1mg. (Fig 1). The amount of food eaten by the snails when treated with copper sulphate increased all concentrations initially and then became static and later continued to increase.

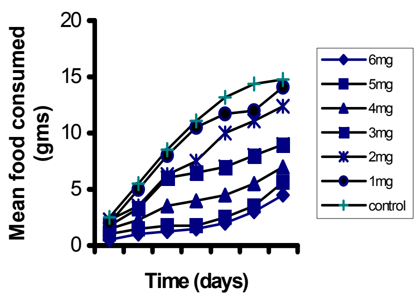


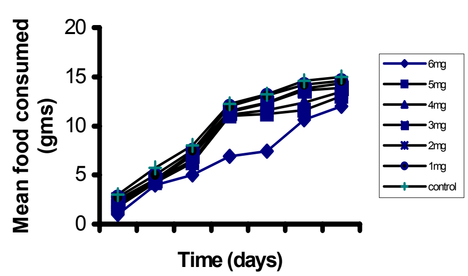
Figure 1: Mean food consumed in grams by Copper treated and Control Snails

The amount of food eaten by the snails tested when treated with Lead acetate increased from 2.75±1.3g on the 3rd bioassay day to 12.0±1.6g on the 12th bioassay day and 14.60±0.4g on the 21st bioassay day using 1mg/L of metal. Also using 3mg/L of metal the amount of food consumed increased from 2.25±1.2g on the 3rd bioassay day to 12.0 ± 1.6g on the 12th bioassay day and 14.60±0.4g on the 21st bioassay day using 1mg/L of metal (fig 2). Linear regression and Logarithmic transformation of "Y" values (food consumption) were considered adequate to characterize groups of behavioural response in this study.

Growth Response

Percentage weight gain copper for copper treated and control *Limicolaria flamea* is presented in figure 3. Animals treated with Low dosages of $CuS0_4$ (1mg and 2mg/L) do not show reduction in weight (mean weight of animals treated with 1mg metal was 84± 2.6g on the 3rd bioassay day and 106 $\pm$2.5g on the 21st bioassay day.

Percentage growth for lead treated and control snails are presented in figure 4. It was observed that similar results were obtained for copper and Lead treated snails. The mean weight of snails was 88 $\pm$3.1g on the 3rd bioassay day 92 $\pm$1.99g on the 15th bioassay day and 65.1 $\pm$ 1.8g on the 21st bioassay day while lead treated snails have a mean weight of 85 $\pm$2.1g on the 3rd bioassay day, 6.8 $\pm$2.4g on the 15th bioassay day and 40. $\pm$1.8g on the 21st bioassay day.



Fi gure 2: Mean food consumed in grams by Lead treated and Control Snails

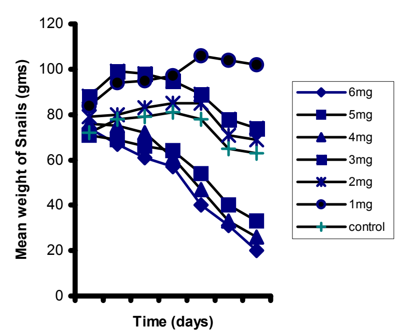


Figure 3. Mean weigth of Copper treated and Control snail

Mortality
A total number of 2 snails died in set up fed with food treated with 1mg copper sulphate and 7 snails died in set up fed with food treated with 6mg copper sulphate. No death was recorded throughout the time of assays in control set up. (Tables 1 & 2).

Two snails died in 2mg and 10 died in 6mg Lead treated food respectively. No death was recorded in the control set up for Lead treated snails as well.

Table 1
Number of deaths in Copper treated and control snails

Days of treatment	Treatment						
	Control	1mg	2mg	3mg	4mg	5mg	6mg
3	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
9	-	-	-	-	-	1	1
12	-	-	-	-	-	-	1
15	-	-	-	1	1	1	1
18	-	1	1	1	1	2	2
21	-	1	1	1	1	2	2
	0	2	2	3	3	6	7

Table 2
Number of Dead Lead Treated and Control Snails

Days	Control	1mg	2mg	3mg	4mg	5mg	6mg
3	-	-	-	-	-	-	-
6	-	-	1	-	1	-	-
9	-	-	-	-	-	2	2
12	-	1	-	1	1	2	3
15	-	-	-	1	2	2	2
18	-	1	-	1	1	1	2
21	-	-	1	-	-	-	1
	0	2	2	3	5	7	10

Key: - = No Death Recorded

DISCUSSION

The acceptance of metal treated food by experimental snails may be because the animal were unable to detect the chemical present in the food due to the reduced concentration (Amusan, 1990) though the food was taken, the lethal effect was high and consequently high moralities were recorded. The lethal effect of these metals is probably due to its accumulation in the body tissues of tested animals. Nuenberg (1984), observed similar results on Molluscs whereby accumulations of heavy metals in land snail resulted in mortalities at higher concentration. Again similar observations were made on earthworms by Morgan & Morgan, 1988 and Sporgeon *et al*; 1994.

Low dosages of copper does not affect feeding activity in *Limicolaria flammea* for example concentration 1mg and 2mg does not affect their feeding responses whereas concentrations of 5mg and 6mg evoked a slow feeding rate. Copper may not cause apparent damage in *Limicolaria flammea* as copper normally occur in Moluscan haemocyanin especially at very low concentration. Therefore snails treated with low copper dosages showed an increase in growth until the 15th bioassay day. Simikiss (1984) had earlier observed similar occurrence in Molluscs.

Linear regression correlating is significant for control and 3mg – 6mg copper treated snails (Table 1) characterized by a regression coefficient b = 13.8+1.2 Linear does not have much effect on food consumption for lead treated *Limicolaria flammea* was 13.2+0.98.

There was no reduction in body weight of snails treated with low dosages of lead until the 19th bioassay day. Snails treated with 1mg/L lead showed a mean decrease in weight from 89±2.10 to 65±1.73g on 18th bioassay day to the 21st bioassay day whereas snails treated with high lead dosages showed a linear decrease in weight from the 3rd bioassay day to the 21st bioassay day using 6mg/L of lead the mean weight of animals decreased from 85+ 2.07g on the 3rd bioassay day and 78+ 2.09g on the 9th bioassay day and 40+1.82g on the 21st bioassay day. At low metal dosages there was no clear relationship between the deaths recorded in correlation with metal dosages, but at high Lead dosages it appears as if there is a relationship between metal dosages, length of exposure and number of mortalities recorded. Correlation coefficient for control was 0.962 $P<0.01$ and at 6mg lead treatment 0.956 at $P<0.01$ and therefore an increased mortality was observed. Similar observations were made by Boyden, (1977) on *Mytilus edulis* fed with Lead and Gumet (1997) on *Helix aspersa* fed with cadmium.

Feeding activity of copper treated snails was found to be metal dosage dependent. Correlation coefficient for control was 0.975 at 1mg treatment ($P<0.01$) and 0.936 at 6mg copper treatment ($P< 0.01$) Lead treated snails does not show any deviation in feeding activity form control snails and weight reduction does not occur in snails treated with low copper dosages while weight reduction occurred in snails treated with Low Lead dosages. Correlation coefficient for control of lead treated snails was 0.966 at 1mg lead treatment ($P<0.01$) and 0.960 6mg lead treatment ($P < 0.01$.

Although *Limicolaria flammea* treated with high Lead dosages showed a great mortality normal environmental levels of this metal would not allow a noticeable mortality in *Limicolaria flammea* population.

Copper is a constituent of Molluscan haemocyanin therefore will not affect mortality of *Limicolaria flammae* and its presence under normal environmental Levels will not cause nay appreciable lethal effect but at certain level of toxicant pronounced mortality effect may result.

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