ACCUMULATION OF COPPER, LEAD AND CADMIUM IN SOME TISSUES OF THE CRAYFISH *PROCAMBARUS CLARKII* (CAMBARIDAE, CRUSTACEA)

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ABSTRACT

Different concentrations of three heavy metals namely copper, lead and cadmium were estimated in different tissues (muscles, carapace and gills) of crayfish *Procambarus clarkii* after it has been maintained in a polluted medium for 2 weeks to determine specific tissue sites of these accumulations. Determination of the heavy metals was carried out by atomic absorption spectrophotometry to both control and treated crayfish. The result generally showed higher metal accumulation in the gills than muscle and carapace, which was increased with raising the concentration of the metals. However, lead exhibited higher accumulation in the carapace.

INTRODUCTION

The crayfish *Procambarus clarkii* is valuable material for the study of aquatic pollution in freshwater ecosystems, since it has been successfully established in various sites of the River Nile and its branches, particularly in Delta region (Ibrahim *et al.*, 1995).

Trace elements that occur in living tissues in small amounts such as Zn, Cu, Mn and Fe are essential while others such as Ag, Cd, Hg and Pb are non-essential. They are present by limited amounts in nature as well as in living organisms. Lead and cadmium are metallic contaminants that have no essential function in human physiology (Barak and Mason, 1990). Copper has a chronic effect on cell maintenance (Hubschman, 1967). Lead has become particularly important because of its relative toxicity and increased environmental contamination via automobile exhaust and high way runoff. Copper was included with the metals to be tested, because of its extreme toxicity to aquatic crustaceans (Corner and Sparrow, 1956 and Bryan, 1971).

Cadmium, a highly toxic metal, has been implicated as both a carcinogen and mutagen. It is bioacumulated and thus when incorporated in tissues of freshwater decapods can have far-reaching effects within aquatic ecosystems as well as in humans (Gillespie *et al.*, 1977; Thorp *et al.*, 1979; Dickson *et al.*, 1982 and Thorp & Gloss, 1986).

Many investigators have studied the occurrence and accumulation of heavy metals in freshwater crayfish such as Meyer *et al.*(1991); Keenon & Alikham, (1991), Suedel, *et al.*(1997) and King, *et al.* (1999).

Moreover, several studies were carried out on the accumulation of some heavy metals in the freshwater crayfish *Procambarus clarkii* (Pastor *et al.*, 1988; Finerty *et al.*, 1990; Madigosky *et al.*, 1991; Naqvi *et al.*, 1993; Anderson *et al.*, 1997 and aqvi *et al.*, 1998).

In Egypt, lack of information in this area of research and the significance of such bioaccumulation process have prompted us to initiate this study on the accumulation of three heavy metals (Cd, Cu and Pb) in various tissue of the treated cray fish (*Procambarus clarkii*).

MATERIAL AND METHODS

Numerous specimens of *Procambarus clarkii* measuring from 8.5 to 11.5 cm in length were collected from El-Kased drain at Tanta city, Gharbia governorate and transferred to the laboratory. Animals were acclimatized to room temperature in glass aquaria for 7 days prior to any bioassay sampling. They were not fed 48 hrs prior to the experiments.

Stock solutions of metal ions were prepared by dissolving lead acetate [Pb $(CH_3CooH)_2 . 3H_2O$], copper sulphate [$CuSo_4 . 5H_2o$] and cadmium chloride ($CdCl_2$) in distillated water. From each metal solution, three concentrations were prepared; 300, 400 and 500 mg/L for copper, 150, 300 and 500 mg/L for lead and 35, 70, 100 mg/L for cadmium. Twenty crayfish were tested in each of the three different metal concentrations and the control.

Samples of the three tissues gills, muscle and carapace were taken for analysis after two weeks of animals exposure, using atomic absorption spectrophotometer.

RESULTS AND DISCUSSION

Table (1) and Figure. (1) show the mean values of accumulated copper in the gills, muscles and carapace of *Procambarus clarkii* after 2 weeks exposure to copper. As the concentrations increased from 300 to 500 mg/L, the mean value of the accumulated concentration of Cu in gills increased from 76.4 to 96.3 mg/g drywt respectively, compared to 2-18 mg/g dry wt in the control. The mean accumulation of copper in muscles and carapace tissues ranged from 0.54 to 11.4 mg/g dry wt and 0.48 to 11.3 mg/g dry wt respectively as compared with the control, where as the accumulation of Cu was 0.176 and 0.293 mg/g dry wt respectively.

From the results, it is apparent that Cu levels were higher in gills than in muscles and carapace. These findings agree with observation of Zia and Alikan (1989) working on copper uptake and regulation in copper- tolerant decapod *Cambarus bartoni*. They found that a highest tissue copper concentration among various treatments was observed in the gills and the lowest in the exoskeleton and muscles.

The data in Table (2) and Figure. (2) show that Pb contents of gills in *Procambarus clarkii* exposed for 2 weeks to 150, 300 and 500 mg/L were higher than those of the control. Pb level ranged as follows: gills, 10.59-41.87 mg/g, carapace, 9.5-24.5 mg/g and muscle, 0.97 – 3.13 mg/g after exposure to 150 –500 g/L Pb. Similar findings were reported by Rubio *et al.* (1991) who showed that the high levels of lead have been reported in the gills.

Table (3) and Figure.(3) show that the highest mean concentrations of cadmium (2.63, 3.84 and 5.66 mg/g) were found in the gills of *Procambarus clarkii* exposed for 2 weeks to 35, 70 and 100 mg/L. The muscles exhibited a level of 0.337, 2.199 and 4.105 mg/g and the carapace 0.102, 0.21 and 3.596 mg/g.

Generally, metal concentrations in the crayfish were high in gills and low in carapace. This was especially true for copper and cadmium. However, lead exhibited higher concentrations in hard tissues such as carapace, which agreed with Braham (1973); Roberts *et al.*, (1976) and Yamamoto *et al.*, (1987) who reported this fact in vertebrate hard tissues such as skin and bone.

So, it is discernible from the results that the present metals showed specific sites accumulations into the exposed organisms. Furthermore, the increase in metal accumulation into several tissues of the crayfish was related to their concentrations in the surrounding media. The highest level of Cu, Pb and Cd concentrations among various treatments were observed in the gills, while the lowest were in exoskeleton and muscle. This accords with George (1984) that the animals gills are the main site of metal assimilation, a fact that explains the serious impact of the aquatic heavy metal pollution and necessity of attempting its control.

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Table (1): Mean concentrations of accumulated Cu (mg/g dry wt) in gill, muscle and carapace of *Procambarus clarkii* exposed for 2 weeks to 300, 400 and 500 mg/L and control.

Concentrations mg/L	Accumulation of Cu mg/ g/ dry wt		
	Gill	Muscle	Carapace
Control	2.180	0.176	0.293
300	76.7	0.54	0.481
400	85.5	2.4	1.26
500	96.3	11.14	11.3

Table (2): Mean concentrations of accumulated Lead (mg/g dry wt) in gill, muscle and carapace of *Procambarus clarkii* exposed for 2 weeks to 150, 300 and 500 mg/L and control.

Concentrations mg/L	Accumulation of Lead mg/ g/ dry wt		
	Gill	Muscle	Carapace
Control	0.66	0.4	0.6
150	10.59	0.97	9.5
300	37.5	2.21	15.18
500	41.87	3.13	24.5

Table (3): Mean concentrations of accumulated Cadmium (mg/g dry wt) in gills, muscle and carapace of *Procambarus clarkii* exposed for 35, 70 and 100 mg/L and control.

Concentrations mg/L	Accumulation of Cad mg/ g/ dry wt		
	Gill	Muscle	Carapace
Control	0.199	0.111	0.011
35	2.63	0.337	0.102
70	3.84	2.199	0.210
100	5.655	4.105	3.596

Table (4): Mean concentrations of copper, lead and cadmium in fresh water.

Heavy metals	Fresh water
Copper	0.116
Lead	0.260
Cadmium	0.025

Fig. (1)

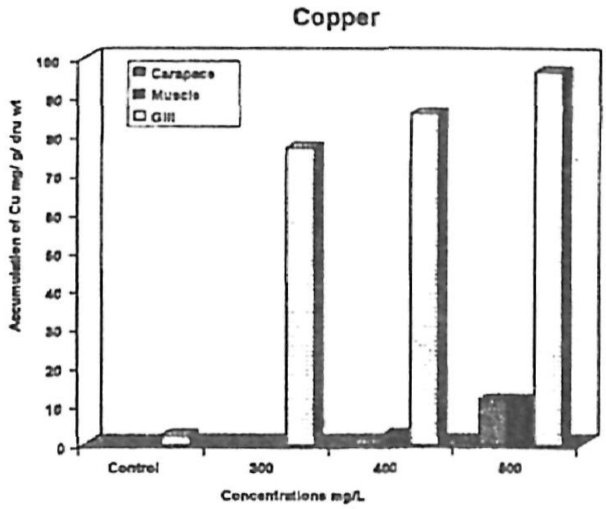

Fig. (2)

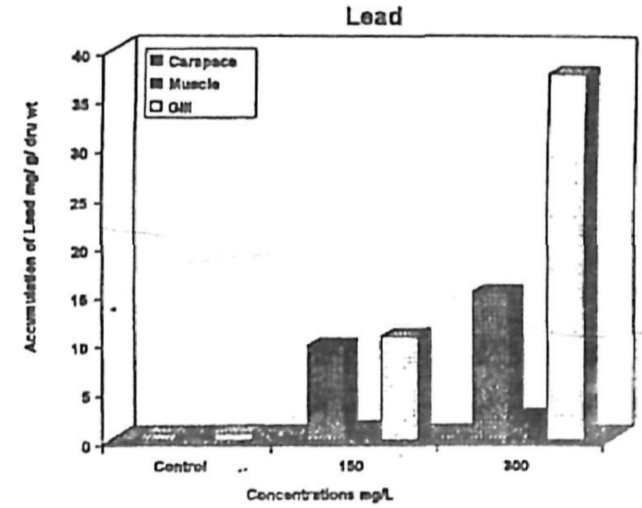

Fig. (3)