ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 8, August 2013

TOXIC EFFECTS OF CADMIUM CHLORIDE ON HEMATOLOGICAL CHANGES IN FRESHWATER FIELD CRAB *Paratelphusa hydrodromous* (DECAPODA: BRACHYURA)

A. M. Padmanaban[1] , K. Mohan[2]

Associate Professor, PG and Research Department of Zoology, Sri Vasavi College, Erode – 638 316. Tamil Nadu, India[1]

PhD Research Scholar, PG and Research Department of Zoology, Sri Vasavi College, Erode – 638 316. Tamil Nadu, India[2]

Abstract: Cadmium, a metal widely used in industrial processes, has been recognized to be a highly toxic and dangerous environmental pollutant. These excess amounts in addition to naturally occurring levels gradually build up to toxic levels causing damages to the biota of the aquatic ecosystem. The fresh water field crab, Paratelphusa hydrodromous is an important human food source in parts of South India. Evaluation of the toxic effect of cadmium chloride on the experimental crab for the LC_{50} value was carried out. The present study evaluates toxicity of cadmium chloride and its impact on hematological changes in the fresh water field crab Paratelphusa hydrodromous.

Key words: Cadmium chloride, *Paratelphusa hydrodromous*, LC_{50} and hematological changes.

I. INTRODUCTION

Environmental pollution by toxicants has become one of the most important problems in the World [1]**.** Cadmium is a nonessential heavy metal but it has accumulative polluting effect, and causes toxicity to aquatic organisms even in minute concentrations. Therefore, it is regarded as one of the most toxic elements in the environment. The occurrence of cadmium in considerably toxic amounts was reported by earlier workers in various aquatic ecosystems [3], [4], [5], [6]. Among heavy metal pollutants, cadmium has been listed in "Black-list" of European community [7], and it is non-essential, non corrosive in nature and highly toxic metal which is distributed and released into the aquatic environment by industrial sources such as mining and refining of ores, Ni-Cd batteries, plating processes, the use of phosphate fertilizers and gasoline containing lead by fishery boats [8]**.** The heavy metals are recognized as serious pollutants of the aquatic environment. Long term contamination are recorded when cadmium is deposited in bottom sedimentation it is highly toxic for aquatic organisms [2] Physico-morphological changes in blood indicate the changes in the quality of the environment for serving the purpose of such bio-indicators. Non-biodegradable metals such as lead, cadmium and mercury accumulate in living organism and cause various disease and disorders.

II. MATERIALS AND METHOD

Healthy and active crabs *Paratelphusa hydrodromous* were collected from the river bed, canals, paddy fields, etc., situated in and around the rivers of Cauvery and Bhavani. Both sexes of crab at their intermoult stage having an average carapace length of 3.0 ± 0.5 cm and breadth of 4.0 ± 0.5 cm were used for this study. They were maintained in a large cement tank (size : Length – 120 cm; Breadth – 60 cm; Height – 100cm) and were acclimatized to laboratory conditions for a week before the experiment in freshwater (salinity - 0.5 ± 0.1 ‰ ; pH – 7.1 ± 0.2 ; Temperature – 28^0 C ± 2^0C) water was changed daily and aerated continuously. The animals were fed daily around 08.00 hrs with soya beans (pre soaked in water).

Each batch of 3 crabs were exposed to a sub lethal concentration (as per 10% LC_{50} value of toxicity evaluation; 20 ppm) and lethal concentrations (200, 400, 600 and 800 ppm) of the medium kept in separate round plastic bowls (10 liter). (A control group of 3 crabs was also maintained at 28^0C ± 2^0C) was similar to those in the holding storage tank.

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 8, August 2013

A short term bioassay to study hematological characteristics was conducted for 96 hrs. Control samples of crabs were also maintained. Haemolymph was withdraw for every 24 hrs by puncturing the arthopodial membrane with 1 ml. syringe and 24 ganged needle which was previously rinsed with 10% sodium heparin. A thin film of haemolymph was prepared with proper care to avoid clogging of the cells and was stained with Lcishman's stain. Haemocytes were examined under microscope using high power and also on oil immersion. Differential counts were made for hyalinocytes, following the usual procedure Haemocytes were counted using haemocytometer following general procedure. Variations in counting of haemocytes and hyalinocytes were compared with the control samples. The date on cell counts was presented based on three replicate of samples collected from three individual crabs and further subjected to statistical analysis.

III. RESULTS AND DISCUSSION

Mircorscopic observations showed the presence of only hyalinocytes which were found to be in large number and granulocytes which could be indentified with the presence of granular cytoplasm. The heamocytes particularly the hyalinocytes were found to occur in clumps after its exposure to sub lethal concentration of cadmium, which would be a possible early sign of agglutination (Fig 1).

Variations haemocyte counts with the effect of sub lethal concentration of cadmium are presented in the Figure: 1. A gradual decrease of hyalinocytes was noted as the duration preceded form 24 hrs. to 96 hrs. Initially the decrease was only 16.72% and it showed a higher decline of 39.2% at 96 hrs of exposure. In average the overall decrease was accounted to be about 28% for the study period of 96 hrs.Analysis of variance (ANOVA) showed a highly significant variation ($F=22.71$; $P<0.01$) in the hyalinocytes of control and experimental samples.. The granulocytes were noted to show the increasing trend when compared to that of control which was statistically significant ($F= 11.28$; $P<0.05$). The increase itself fluctuated during the study period and it ranged from 11.07% (24 hrs.) to 20.65% (48 hrs). The overall increase was recorded as about 20%.

In the present study, haemotological variations in terms of the number of cells and also the histopathological changes could be noted for this freshwater crab P.hydrodromous with the toxicity of cadmium. Two types of haemocytes granulocytes could be recorded. Earlier observations presented much variablity in the types of halmocytes in marine and estuarine crabs. The tanner crab Chinocetes bairdi was found to contain three types of circulating haemocytes which were as hyalinocytes, intermediate granulocytes and oesinophilic granulocytes [9]. Haemolymph clotting was attributed for the three types of haemocytes on the basis of their own size and the size of the granules which were Callinaetes sapicus [10].

Hepatopancreas was interestingly designated further as a haemopoietic organ, differentiating seven types of circulating haemocytes (A, B, C, D, E, F, G) in the crab Ocypode ceratophthalmus [11]. The share crab, Carcinus maenas was earlier found to contain only two types of haemocytes (hyabinocytes and granulocytes) as observed for P.hydrodromous **[12].** Based on the nature and distribution of granules, there were four ; Hauton types of haemocytes were observed in Eriocheir Sinensis [13]. In Indian horse stive crab Tachyplews gigas amoebocytes were found to be the only circulating haemocytes [14].

The haemocytes were found to be responding to the toxicity of cadmium in this study. Sub lethal level of cadmium on the exposed crab for 96 hrs caused a gradual reduction in the number of hyalinocytes as the duration proceeded. However, the granulocytes accounted variably in number. Any kind of stress would induce the change in the hematological characteristics. As observed in here, similar study earlier showed cadmium induced a continual reduction in haemocytes in P.hydrodromous whereas the oesinophilic granulocytes were selectively altered [15].

Even higher salinity stress in the freshwater field crab Oziotelphusa sensex sensex could induce higher concentration of granulocytes rather than halmocytes in the haemolymph [16]. Further microbial infestation could increase the granulocytes and decrease the hyalinocytes in a tanner crab Chinocetes bairdi [17].

The agglutination of haemocytes was also noted with the effect of cadmium induced stress in this study. The formation of haemocytic clump was noted similarly when the shore crab Carcinus malnas was exposed to Beta 1,3 – Glucan. The haemocytes was found to become sticky and adherent as a cellular defence reaction to a stress when C.maenas was injected with bacteria **[12].**

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 8, August 2013

IV. CONCLUSION

The present studies two types of haemocytes such as hyalinocytes and granulocytes could be observed in Paratalphysa hydrodromous, while the hyalinocytes showed a decline in number progressively, the granulocytes counts were found to be fluctuating with an initial rise and a final fall, with the effect of cadmium. This was followed by the agglutination of these haemocytes. The decrease of hyalinocytes in number would be a pathological manifestation and the fluctuating number of granulocytes was probably the outcome of the onset of cellular defence mechanism to the demand for the physiological stress produced by the metal cadmium. It could be concluded that the metal cadmium was certainly toxic to this freshwater crab Paratalphysa hydrodromous.

REFERENCES

[1] R. Chandran, A.A. Sivakumar, S. Mohandass, M. Aruchami, "Effect of cadmium and zinc on antioxidant enzyme activity in the gastropod," *Achatina fulica*. *Comp. Biochem. Physiol*. 140, 422–426, 2005.

[2] D. Leontovičová, Complex monitoring in selected profiles of state networks of water quality follow up in CHMU Periodicum fakulty ekologie an enviromentalistiky Technickej *university Vozvolene*, 10, 2003.

[3] Arno Kaschl, Volker Römheld and Yona Chen, "Cadmium binding by fractions of dissolved organic matter & humic substances from municipal solid waste compost." *Journal of Environment Quality*, 31, 1885-1892, 2002.

[4] S. Audry, J. Schafer, G. Blanc, J. M. Jouanneau, "Fifty year Sedimentary record of heavy metal pollution (Cd, Zn, Cu, Pb) in the Lot river reservoirs (France)." *Environmental Pollution*, 132, 3, 413-426, 2004.

[5] Chrastny, M. Komarek, P. Tlustos, J, Svehla, "Effects of flooding on lead and cadmium speciation in sediments from a drinking water reservoir." *Environmental Monitoring and Assessment*, 118,13, 113-123, 2006.

[6] B.R. Kiran, T.R. Shashi Shekhar, E.T. Puttaiah and Y. Shivaraj, "Trace metal levels in the organs of Finfish *Oreochromis mossambicus* (Peter) and relevant water of Jannapura lake, India." *Journal of Environmental Science & Engineering*, 48, 1, 1520, 2006.

[7] F.Mason, *Biology of freshwater pollution.,* III Ed., Longman, U.K. 1-4. 1996.

[8] USATSDR (United States Agency for Toxic Substances Disease Registry) Toxicological Profile for Cadmium. *Published by U.S. Department of Health and the Human Services. Public Health Services*. 229-240, 1999.

[9] M.C. Mix and A.K. Sparks, "Tanner crab Chionocetes bairdi Rathbun, haemocyte classification and an evaluation of using differential counts to measure infection with the fungal disease." *J. Fish. Dis.*, 34 2, 85-293, 1980.

[10] A.S. Clare, and G. Lumb, "Identification of haemocytes and their role in clotting in the crab Callinectes sapidus." *Mar. Biol.* 118,4, 601-610, 1994.

[11] P.K. Remlath, and R.G. Adiyodi, "Cells of inter tubular region of the hepatopancreas of the ghost crab, Ocypode ceratophthalmus." *J. Anim. Morphol. Physiol.,* 42, 1-2, 75-78, 1995.

[12] V.J. Smith and N.H. Ratcliffe, "Host defence reactions of the shore crab, Carcinus maenas (L.) In Vitro." *J. Mar. Biol. Ass.* U.K., 58, 2, 367-379, 1978.

[13] L. Hongda, Classification and morphological observations of haemocytes in Eriocheir sinensis by light and electron microscopes. Acta. Hydrobiol., Sin – Shuisheng – Shengwu – Xuobao. 2002.

[14] Joshi, A. Chatterji and R. Bhonde, "Long term in vitro generation of amebocytes from the Indian horseshoe crab Tachypleus gigas (Mueller)." *Cell. Der. Biol. Anim*, 38,5, 255-257, 2002.

[15] B. Victor, "Responses of haemocytes and gill tissues to sub lethal cadmium chloride poisoning in the crab Paratelphusa hydrodromous (Herbst)." *Arch. Environ. Contamin. Toxicol*., 24, 4, 432-439, 1993.

[16] M.V.V.Subramanyam and R.V. Krishnamoorthy, "Haematological changes in the field crab on adaptations to higher salinity." *Indian. J. Mar. Sci.*, 10,1, 101-102, 1983.

[17] M.C. Mix and A.K. Sparks, "Tanner crab Chionocetes bairdi Rathbun, haemocyte classification and an evaluation of using differential counts to measure infection with the fungal disease." *J.Fish.Dis.*,3,4,285-293,1980.

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 8, August 2013

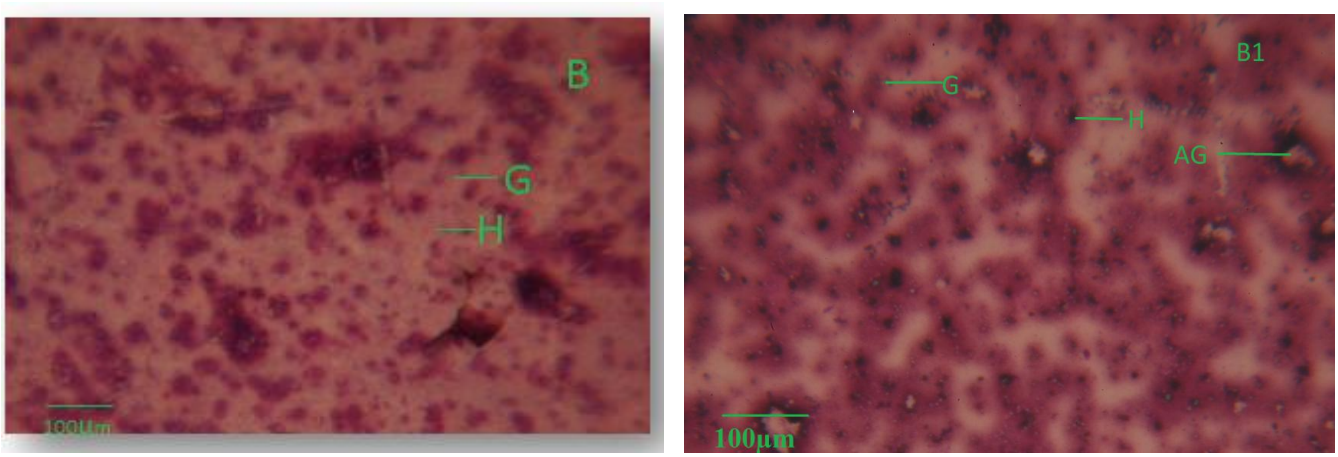

Fig. 1: Blood smear of P.hydrodromous exposed to sub lethal concentration of cadmium for 96 hours

B = CONTROL; B1 = EXPERIMENTAL;
B, B1 = 10 x 40x
H = Hyalinocytes
G = Granulocytes
AG = Agglutination

ISSN: 2319-8753

International Journal of Innovative Research in Science, Engineering and Technology

(ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 8, August 2013

Fig 2: Effect of sub lethal concentration of cadmium on haemocytes of the crab p.hydrodromous