

HEMATOLOGICAL AND PHYSIOLOGICAL RESPONSE TO ACUTE CONCENTRATIONS OF LEAD ON FRESH WATER FISH *CARASSIUS CARASSIUS*.

Al Zobidy A. M. H.

Department of Physiology ,College of Veterinary Medicine, University of Basrah,Iraq

(Received 15 August 2006,Accepted 20 October 2006)

Key words:Lead,Blood ,Ionic balance.

ABSTRACT

Selected specimens of *Carassius carassius* fish were exposed to acute lead concentrations (15 , 30 and 45 Mg/L), for tow periods 48 and 96 hrs. The exposure to lead occurred changes in some blood parameter in treatment fish., There was an increasing in the R.B.C. , Hb, M.C.H., blood glucose and blood lactic acid , These changes were more clear after 96 hrs. Whereas values of PCV and MCV showed decline significantly, blood serum also appeared disturb on ionic balance represented by decreasing in(Na^+ , K^+ and Ca^{+2}) after(48 and 96) hours in treatment fish compare with control specimens.

INTRODUCTION

Most of the Physiological studies on heavy metals toxic in aquatic ecosystems were showed toxicity a complete loss of growth and mortality of organisms (1). Most organisms are exposed via the direct uptake of free ions from water through respiratory surface, but exposure may also occur through along accumulation by food chain or through ingestion of contamination sediments (2) .

The lead have ability to precipitate upon the gills epithelium surface and penetrate through blood circular (3) . many of researches emphasized that the lead and copper have highly effects on gills and ATPase enzymes (4) which associated with damage of ionic balance , increasing of sodium efflux and number chloride cell in the gills (5) , finally causes behavioral and physiological changes in fish (6) .

lead toxicity on aquatic organisms tend to be highest under conditions of low pH , decrease dissolved oxygen and elevated temperature (7) . The effects including disturbances the osmoregulation , respiration , tissue damage and reduced energetic resources (8).

The current studies have been focused on hematological and physiological variables and their relationship with respiration (hemoglobin content and related parameters) and defence energetic (metabolite levels) Changes of blood parameters are often quick response to environmental or physiological alteration , furthermore , they provide an integrated measure of physiological status of organism (9) .

The purpose of this study are determine quantitative measurement of hematological and physiological alterations in the freshwater fish, (*C. carassius*) exposed to three acute concentrations of lead .

MATERIALS AND METHODS

Medium size specimens (weigh $40 \text{ g} \pm 3$) of *C. carassius* collected from local fresh water source (Marine science center Ponds) and acclimatized for 7 days to laboratory conditions Glass aquaria containing 120 L. of aerated tap water (pH = 7.8 ± 1 , hardness $460 \text{ mg} \setminus \text{L}$ and temperature (27 ± 3) were used .

The treatment fish were exposed during (48 and 96 hrs.) to three acute concentrations of lead (15 , 30 and $45 \text{ mg} \setminus \text{L}$) . During the experimental , the photoperiod was held natural and the water was renewed daily . Testes fish were stopped

of fed placed in each of (60 X 40 cm) aquariums . 20 animals per concentration , 2 replicates per each concentration and 10 fish per replicate , as well as , 10 fish remaining as control . The blood was obtained by caudal vein or artery collected into heparinized tubes .

Erythrocytes was determined by standard haemocytometer (10) . Hemoglobin content was measured according to (11) . Blood glucose was estimated by method of (12) . Lactic acid content of blood was determined using the procedure of (13) .

The serum ions concentrations (Na^+ , K^+ and Ca^{+2}) were measured after separating the serum and dilute it by distilled water , and analysis by flame photometer .

RESULTS

Table (1) summarizes The effects of acute concentrations (15 , 30 and 45 Mg \ L. Lead) on hematological parameters of *C. carassius* after 96hrs. of exposure period , Acute exposure of lead apparent decrease of Packed cells volume , and mean corpuscular volume (MCV) whereas , the erythrocytes count , hemoglobin and mean corpuscular hemoglobin concentration after 48 and 96 hrs. were increased respectively . It seems that the glucose and lactic acid were not affected after 48 hrs. , but the period increased to 96hrs. the glucose showed higher significantly in the concentrations (30 and 45 mg \ L.) , while lactic acid level was different significant only in concentration 45 mg/l .

Table (3) shows the serum ions concentrations (Na^+ , K^+ and Ca^{+2}) in survived fish after 48 and 96hr. of exposure to lead , the highly concentration caused significant decrease ($p < 0.05$) in sodium , potassium , and calcium compare with control .

Table 1 : Effect of acute concentrations (15 , 30 & 45) Mg/L of lead on some of blood parameters in fish .

Period	Lead Conc. (Mg\L)	RBC (count X 10^6)	Hb content (Mg\100ml)	PCV (%)	MCV (fi)	MCH (pg)
48hrs.	Control	1.6 $\pm$ 0.56 a	11.8 $\pm$ 0.62 a	40.5 $\pm$ 0.8 a	370.1 $\pm$ 11.8 a	100.3 $\pm$ 7.9 a
	15	1.7 $\pm$ 0.8 a	11.5 $\pm$ 0.71 a	41.6 $\pm$ 0.2 a	349 $\pm$ 9.5 ab	88.9 $\pm$ 9.1 b
	30	1.18 $\pm$ 0.78 a	12.8 $\pm$ 0.35 b	38.6 $\pm$ 0.9 b	339.6 $\pm$ 9.6 b	108.6 $\pm$ 10 a
	45	1.41 $\pm$ 0.90 a	12.9 $\pm$ 0.48 b	38.1 $\pm$ 0.5 b	283.3 $\pm$ 11 c	89.14 $\pm$ 1.8 b
96hrs.	Control	1.36 $\pm$ 0.08 a	10.0 $\pm$ 0.35 a	40.3 $\pm$ 0.5 a	300.5 $\pm$ 14.8 a	80.4 $\pm$ 7.1 a
	15	1.50 $\pm$ 0.08 b	10.75 $\pm$ 0.75 ab	38.1 $\pm$ 0.5 b	268.9 $\pm$ 10.5 b	78.53 $\pm$ 10 a
	30	1.55 $\pm$ 0.13 b	10.33 $\pm$ 0.38 b	33.9 $\pm$ 0.6 c	220.9 $\pm$ 18.5 c	76.17 $\pm$ 10 a
	45	1.58 $\pm$ 0.15 b	14.0 $\pm$ 0.75 c	33.4 $\pm$ 0.3 c	218.1 $\pm$ 14.5 c	99.8 $\pm$ 13 b

The different letters indicate to significant deference among the treatments and control groups at the : 0.05 level

Table 2 : Effect of acute concentrations (15 , 30 & 45) Mg/L of lead on glucose and lactic acid concentrations in blood of fish .

Period	Lead Conc. (Mg/L)	Glucose Blood (mg\100ml)	Lactic acid (mg\ 100ml)
48 hrs.	Control	34.6± 3.0 a	12.9 ± 1.9 a
	15	34.3 ±2.1 a	12.85 ± 1.4 a
	30	35.2 ± 1.8 a	16.5 ± 3.5 a
	45	34.5 ± 2.9 a	15.1 ± 4.0 a
96hrs.	Control	33.3 ± 1.1 a	13.1 ± 1.4 a
	15	34.1 ± 1.0ab	14.9 ± 1.8 a
	30	35.8 ± 0.9 b	14.3± 2.0a
	45	35.9 ± 0.9 b	18.9 ± 1.9 b

The different letters indicate to significant deference among the treatments and control groups at the : 0.05 level

Table 2 : Effect of acute concentrations (15, 30 ,&45) Mg/L of lead on Sodium , Potassium and Calcium concentrations in serum .

Period	Lead Conc. (Mg/L)	Ions Concentrations (Mlimol\Liter)		
		Na ⁺	K ⁺	Ca ⁺⁺
48 hrs.	Control	131 ± 1.5a	8.6 ± 0.16 a	3.6 ± 0.13 a
	15	128 ± 2.5 a	7.6 ± 0.10 b	3.6 ± 0.18a
	30	113 ± 3.0b	6.3 ± 0.12c	2.3 ± 0.20b
	45	104 ± 5.2b	6.0 ± 0.31c	2.6 ± 0.13 b
96hrs.	Control	131 ± 2.3 a	9.2 ± 0.2 a	3.8 ± 0.23 a
	15	113 ± 1.3b	8.4 ± 0.21b	2.1 ± 0.12 b
	30	100 ± 3.1c	7.0± 0.10c	1.9 ± 0.20b
	45	85.2± 8.0d	6.4 ± 0.4 c	1.3 ± 0.37c

The different letters indicate to significant deference among the treatments and control groups at the : 0.05 level

DISCUSSION

The many of alteration in hematological parameters was showed after exposure to heavy metals , generally , because of changes in water content of blood both haemoconcentrations and haemodilution have been described in different experiments . For instance haemoconcentration after Cu⁺² exposure and haemodilution after exposure to Zn⁺² have been observed in *Colisa fasciatus* (14) . In the present study decrease of Packed cell volume appeared during 48 and 96 hrs. of lead exposure was indicative of haemodilution .

The elevation in number of erythrocytes is comparable with observations made by (15) . *Colisa fasciatus* exposed to Cr⁺² , Ni⁺² and Cu⁺² , noticed of similar increase in the erythrocytes were also showed in other fish exposure to Co⁺² (16) and pulp mill effluents (17) .

The increase erythrocytes count probably reflect a hypoxic stress exposure was resulting in secondary polycythemia . The increase in the erythrocytes counts also explains the retardation of erythrocytes sedimentation rate . At 96hrs. of exposure to lead the hemoglobin content was significantly lower compare with control values . Theses results could be associated with some action of Pb⁺² on heme metabolism , since several authors

have described interactions between heavy metals and enzymes involved in heme metabolism (18).

The changes of blood glucose and lactic acid levels of *Carrassius auratus* depend on level of intoxication , Concentrations of pollutants and the exposure periods . Blood levels of the glucose and lactic acid were greatly increased with the pollutant concentrations and exposure time . This high levels of glucose and lactic acid was usual response to the stress (19) .

The results showed decrease in the ionic content (Na^+ , K^+ and Ca^{+2}) of serum in all concentrations of lead . (20) which conformed the active uptake of salts through the gills was affected after exposure to heavy metals such as Cu^{+2} and Pb^{+2} due to the reducing of activity of Na^+ , K^+ and Ca^{+2} ATPase enzymes in gills . These enzymes is response of active uptake of salts through the gills tissue (21) .

It seems that the exposure to different concentrations of heavy metals over longer period caused increasing passive permeability to Na^+ , K^+ and Ca^{+2} (22) .

الاستجابة الفسلجية والدموية في الأسماك الذهبية *Carrassius carrassius* المعرضة لتراكيز حادة من عنصر الرصاص

عادل موسى حسن

فرع الفسلجة ، كلية الطب البيطري ، جامعة البصرة ، البصرة ، العراق .

الخلاصة

عرضت الأسماك الذهبية إلى تراكيز حادة من عنصر الرصاص (١٥ ، ٣٠ ، ٤٥) ملغم / لتر لمدة ٤٨ ساعة . أظهرت الأسماك المعاملة بالرصاص تغيرات في العديد من القياسات الدموية ، لوحظ ارتفاع عالي المعنوية عند استخدام التركيز العالي من الرصاص (٣٠ و ٤٥ ملغم / لتر) وخصوصا خلال الفترة ٩٦ ساعة مقارنة مع ٤٨ ساعة والتركيز ١٥ ملغم / لتر . فقد اظهر عد خلايا الدم الحمر وتركيز خضاب الدم وكتوكوز وحامض الاكتيك في الدم زيادة في معدلاتها مقارنة مع مجموعة السيطرة ، فيما لوحظ انخفاض قيم حجم الدم المضغوط . الرصاص اثر بشكل ملحوظ على مستوى التنظيم الأيوني للأسماك المعاملة إذ سجلت انخفاضا في مستوى تركيز ايونات كل من الصوديوم والبوتاسيوم والكالسيوم بعد ٤٨ و ٩٦ ساعة من التعرض مقارنة مع مجموعة السيطرة .

REFERENCES

- 1- Julie , C. (1998) . In vitro response to ACTH of internal tissue of rainbow trout exposure to cadmium . Aqua. Toxcol. 42 : 103 – 113 .
- 2- Koeman , J. H. and Strik, J. J. (1976) . Sublethal effects of toxic chemical on aquatic animals . Elsevier Scientific publishing company Amsterdam pp: 234
- 3- Hughes , G. M. (1981) . Effect of low oxygen and pollution on the respiratory system of fish . In: A. D. Pickring (ed.) Stress and Fish . Academic Press .
- 4- Burton , D. T. ; Jones , A. H. and Cairns , J. Jr. (1972) . Acute zinc toxicity to rainbow trout (*Salmo gairdneri*) Confirmation of the hypothesis that death is related to tissue hypoxia . J. Fish Res. Bd. Ca. 29: 1463 – 1600 .
- 5- Bryan , G. W. (1976) . Some aspects of heavy metal tolerance in aquatic organisms . In: A.M.P. Lockwood (ed.) Effects of pollutants on aquatic organisms . Cambridge Univ. Press .

- 6- James , V. A. and Wisham , T. (1986) . The effects of Cd on prolactin cells activity and plasma cortisol levels in the rainbow trout (*Salmo gairdneri*) . Aqua. Toxicol. , 8 : 273 – 280 .
- 7- Wright , D. A. (1994) . Lead in aquatic environment review of ecological and toxicological effects on biota . Environment. Rev. 3: 188 – 270 .
- 8- Heath , P.B. (1995) . Water pollution and fish physiology , Boca Raton , FI : CRC press .
- 9- Chazaly , K. S. (1992) . Physiological responses to sublethal concentrations of lead in *Cyprinus carpio* fish . Water , Air and Soil pollution . 69 : 551 – 559 .
- 10- Dacie , J. V. and Lewis , S. M. (1984) . Partical heamatology , Churchill Livingston (ed) , selecto printing Co. Itd., New York , 445 pp .
- 11- Osler , B. L. (1965) . Hawks physiological chemistry , 14th ed. Mc. Graw Hill, New York .
- 12- Varly , A. (1980) . / Particle clinical biochemistry 4th (William , Heinman ed .) Meducal – books ltd London .
- 13- Barker, I.(1963).In colowick S . P. and Kaplan (eds) . Methods in enzymology , Academic press , New York 3 : 41 .
- 14- Mishra , S. and Srivastara , A. K. (1980) . Effects of metal exposure on blood parameters in rianbpow trout . Ecotoxicol. Environ. Saf. 5 : 1099 .
- 15- Srivastara , A. K. ; Agrawal, S. J. and Chaudhry , H. S. (1979) . Effects of some heavy metals on colis foscitus . Acta. Pharmacol. Toxicol. 44 : 197 – 201
- 16- Frovola , L. K. (1960) . Effects of metals on blood parameters in fish . Doki . Akad . Nauk SSSR 131 , 983 .
- 17- McLeay , D. J. (1973) . Long – term sublethal physiological effect on *Galis fasciatus* during exposure to pulpmill effluent . Gen . Comp. Endocrinol . 48 : 423 – 429 .
- 18- Dalwani , R. Dava , J. M. and data , K. (1985) . Aquatic chemistry an introduction emphashing chemical equilibria in natural water , 2nd , New York 883 .
- 19- Soivio , A. and Oikari , A. (1996) . The effect of metal metabolism on uptake , disposition and toxicity in fish . Aqua. Toxicol. Pp: 235 – 241 .
- 20- Eddy , F. B. (1981) . Effect of stress on osmotic and ionic regulation in fish . In : A.D. Pickring (ed.) : Stress and fish . Academic Press .
- 21- Renzis , G. and Bronanin , M. (1984) . Ion transport and gill ATPase . In: Hoar, W. S. and Randall , D. J. (eds.) : Fish physiology . Vol. XB. Academic Press Inc .
- 22- Eddy , F. B. and bath , R. N. (1979) . Effects of lanthanum on sodium and chloride fluxes in the goldfish (*Carassius auratus*) . J. Exp. Physiol. . 129: 145 – 149