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A Comprative Study of an air breathing fish & non-air breathing fish under cadmium toxicity

Amita Kumari* & Sanjeev Kumar Jha
University Department of Zoology, B.N Mandal University, Madhepura,Bihar
Patna university Patna

Abstract :

Almost all heavy metals and their salts have oftenly been proven as an important group of environmental pollutants becaues they are potent metabolic inhibitors. Cadmium is non essential trace element with no biological function and highly toxic to marine and fresh water aquatic life. Several studies have shown that cadmium accumulates in specific site in the body rather than being distributed evenly throughout. In this investigation an assessment of effect of the heavy metal (Cadmium) on biochemistry of blood serum has been taken as the prime consideration because blood is good patho-physiological indicator. H-fossilis (air breather) and M.seenghla (Non-air breather) were used as test animals. Both species of fishes responded differently to the same toxicant and for the same duration of exposure. In H-fossilis there was decreasing trend in glucose, total protein, Cholesterol, urea and creatinine value while in M. Seenghala only glucose and sodium exhibited -ve trends, but all other parameter showed elevation in their value as compared with the control fish.

KEY WORDS : H. fossilis, M. Seenghala, Cadmium, Glucose, Cholestrol, total lipid, Urea, Creatinine.

Introduction :

This much is sure that environmental problem have increased exponentially in recent decades. Both developed and developing countries are facing different forms of water pollution. Developed countries facing water pollution problem as a result of industrial proliferation and modern agro-technologies are now on the way of combating the problem through improved waste water treatment techniques, but developing countries including India are far behind in this regard due to poor waste water treatment technique, weak implementation of environmental policies and limited financial resources.

It has been reported that various aquatic reservoirs in India receives a heavy flux of sewage. Industrial effluents, domestic and agricultural waste (Gross, 1978, Galloway 1979) which consists of varying hazardous chemicals. The heavy metals are added up day by day where they persists for ever without being broken down to harmless substance (Sen Gupta and Kureshly 1989) Nariagu (1983) emphasized elaborately on effect of cadmium on aquatic organism.

Review of literature shows ample reports and evidences of effect of cd on fish haematology. Blood is good bio-indicator as all the major or minor bio-molecules are get dissolved in blood and bio-chemical changes in blood of fish under exposure to any toxicant may be used to predict effect upon chronic exposure. The present investigation shows a comparative study of a air breathing fish. *H.fossilis* and a non-air breathing fish M.seenghala under the sublethal Cd concentration. Effect were studies on some serum biochemical parameters.

Materials & Methods:

Live and healthy fishes of both species, *H-fossilis* and M.seenghala were collected from the local fish market of Saharsa. All the fishes were first thoroughly washed and them rinsed with 0.1% $KMnO_4$. After acclimation for a fortnight. 42 fishes of each categories were selected for experiment, irrespective of their sex. The average length and weight of *H-fossilis* was 14±1 cm and 60 ± 5gm. The average length and weight of *M.Senghala* was 7±1cm and 35 ± 3 gm. Before starting the experiment toxicity test were conducted to determine the LC_{50} and Safe concentration value of $CdCl_2$ for 96 hrs. The standard method published by A.P.H.A. (1992) was used to analyze the Physico-chemical condition of water. Both the fishes were divided into 4 equal group of 6 fishes each. First 3 groups of both the fishes were exposed to sub lethal concentration of $CdCl_2$ separately for 96 hrs. 15days and 30 days. Sublethal concentration of $CdCl_2$ for *H-fossilis* was 3.2ppm and for *M.seenghala* it was 2.0ppm. Fourth group were treated as control for respective group. All the fishes were fed once daily during the experiment period. Both treated and control fishes were sacrificed at time interval and blood was collected by serving the caudal peduncle using a sharp knife.

Blood serum were separated from the formed elements through the centrifugation at 3500 rpm for 15 minutes. Following five bio-chemical parameters were analyzed in serum, are

1. Glucose (mg/100ml.) - GOD POD Method of Trinder
2. Cholesterol (mgm/dl) - CHODPAD Method of R. Kettermann.
3. Total Protien (gm%) - Biuret method of T.E. welchelbaum.
4. Urea (mg%) - DAM method of D.R. Wy benga
5. Creatine (mg/dl) - Jaffs method of H.P. Seiling and H. West

Result:

No mortality in the both species of fishes were recorded exposed to sub lethal concentration of cadmium chloride during the whole span of the experiment. Certain morphological and behavioral changes like coloration, feeding behavior, activeness etc. were observed up to some extent. Both species of fishes initially become more active but gradually they become sluggish.

TABLE – I

Serem Bio-molicules data of the H.fossilis exposed to Cadmium Chloride (3.2ppm.)

Sl. No.	Parameter	Controll	96 hrs.	15 days	30 days
1.	Glucose	47.0	32.3	27.4	21.4
2.	Cholesterol	170.0	185.0	192.0	209.0
3.	Total Protein	4.0	4.2	4.2	5.4
4.	Urea	16.3	16.5	17.1	18.4
5.	Creative	0.2	0.3	0.4	0.5

Table - I shows the bio-molecule indices recorded from exposing *H.fossilis* to 3.2 ppm of cadmium chloride for 96 hrs. 15 days and 30 days. Difference were measured against the control under laboratory conditions. The value of glucose shows a gradual fall of 54%. Where as cholesterol total protein, creatinine and urea level show a regular increase.

TABLE – II

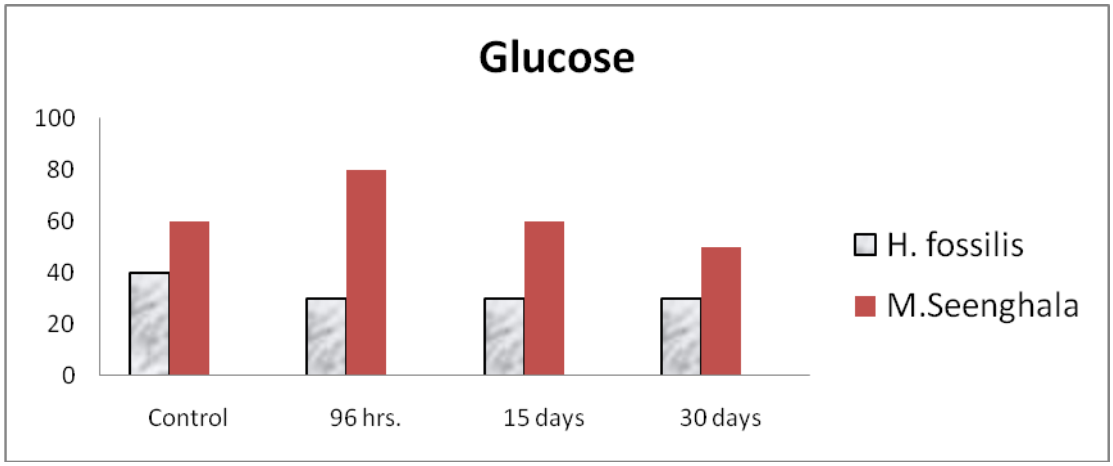
Serum bio-molecules data of the *M.Seenghala* exposed to cadmium chloride (2.0ppm).

Sl. No.	Parameter	Controll	96 hrs.	15 days	30 days
1.	Glucose	66.0	86.0	72.0	60.0
2.	Cholesterol	266.6	210.0	170.0	104.0
3.	Total Protein	7.0	7.5	8.0	70.0
4.	Urea	20.6	20.5	18.3	15.2
5.	Creative	0.9	0.6	0.5	0.3

Table – II *M.seenghala* responded slightly different from *H.fossilis*. This species showed a fluctuating result in all parameters. Glucose level initially increased up to 29% but later it decreases lower than normal level. Cholesterol, Urea and creatinine had a regular decreasing trend up to 66% but again total protein value increases 14% up to 15 days but it become lower to normal value in 30 days of exposure.

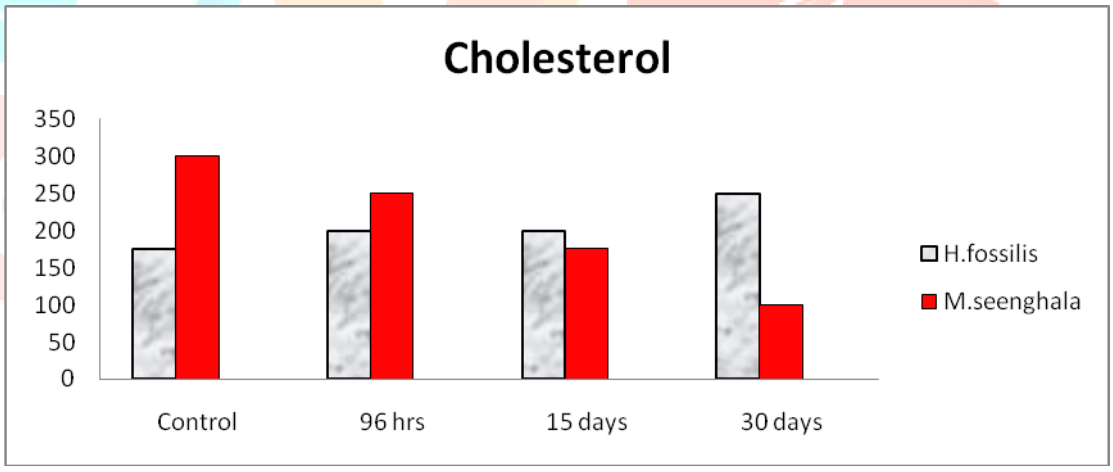
Discussion:

Bio-molecules parameter are the best indicators of stress situation caused by heavy metals. Toxicity tests showed that cadmium is more toxic to non-air breathing fishes. The glucose level of *M.Seenghala* showed initial increase and then a decrease. It may be due to liver impairment to utilize glucose for glycogenolysis (Shastry and Sunita, 1982).This situation may be attributed to higher activity of enzymes participating in gluconeogenetic metabolism. Since enzymes of gluconeogenesis are reported to be induced by various toxicants specially cadmium (Shaikh and Hiradhar, 1985).



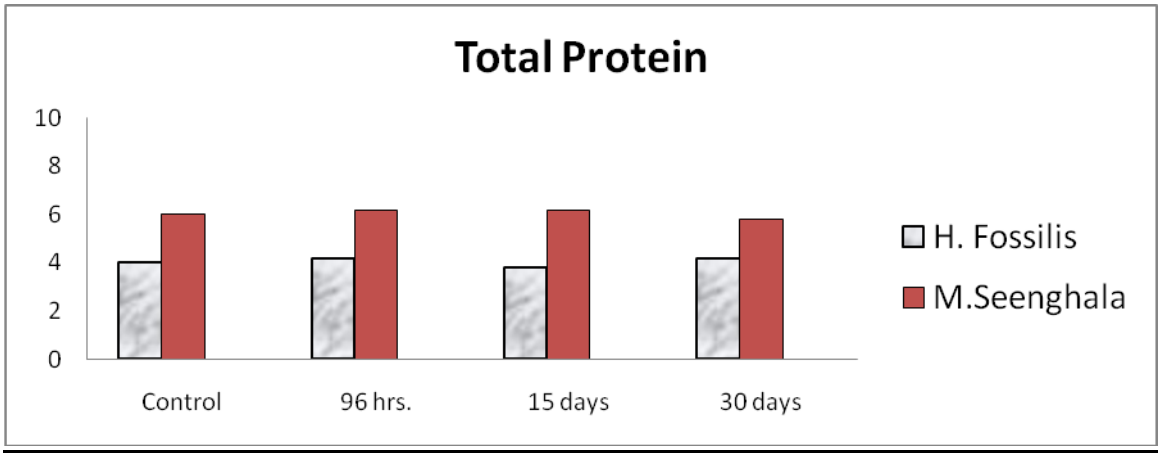
Histogram I : Showing alteration in blood glucose level in both the fishes.

H.fossilis showed increase in cholesterol value while a slow decrease was observed in *M.Seenghala* (Histogram – II) Review of literature (Kurde, 1990) shows that 60-80% of total serum cholesterol is in esterified form and esterification normally occurs in liver. It is obvious that cadmium damages the liver southe proportion of esterified cholesterol decreases. Keeping in view of the above observation the inference may be drawn that hyper cholesterdemia observed in *H.fossilis* may be due to impairment of liver and in habitation of enzymes, which converts cholesterol in to bile acid (Murvey, 1990).



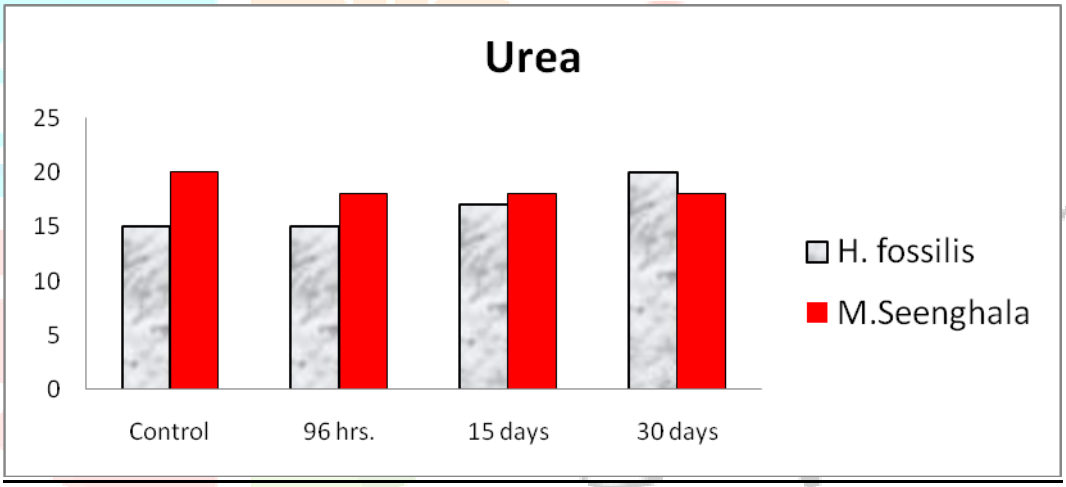
Histogram II : Showing Cholesterol level in both the fishes.

Almost all enzymes and hormones which play an important role in the different biological activities are made up of protein, so protein play an important role in the physiology of living beings. Proteins are too sensitive and early indicators of heavy metal poisoning. (Kapila Manoj, 1999 & Kurde, 1990 pointed out elevation in protein content of rat serum, B.Rajanna et. al. (1981) has also reported enhancement in protein contents due to cadmium. The increase in protein content was due to enhancement of microsomal protein synghesis suggested by various authors.



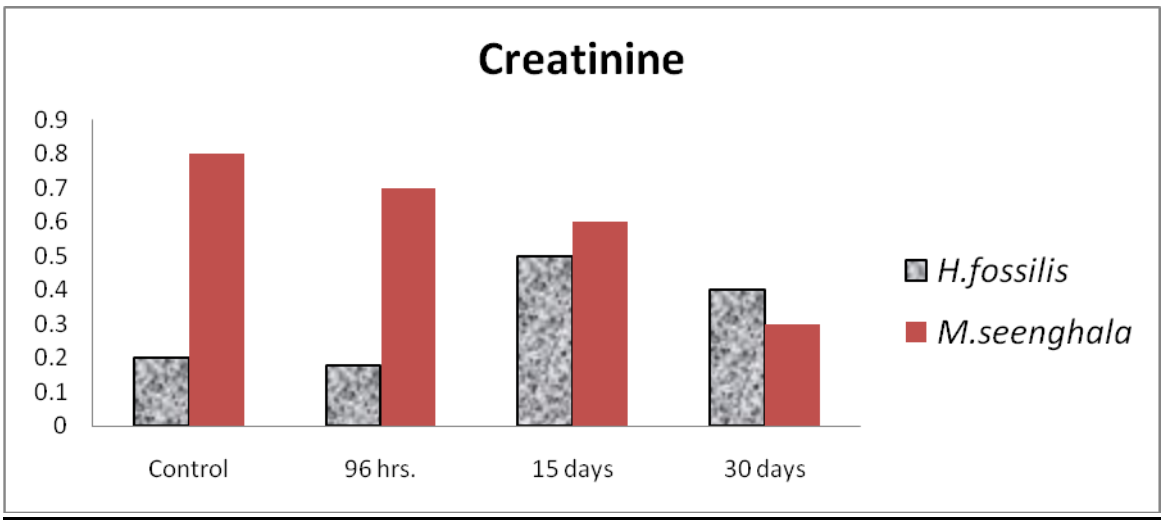
Hetrogram III : showing changes in serum total protein level.

So far as the excretory habit of teleosts are concerned primarily they all are ammotelic but a significant amount (about 20% or more) of urea have also been reported to occur as the total nitrogenous excreta occurring of uremia was reported by various workers (Gupta & Bkargava, 1985, Kurde 1990). Renal disorder also causes elevation of serum urea level.



Hetrogram IV: Showing changes in serum urea level.

Creatinine is another nitrogenous waste product eliminated by the Kidney, when excretion is suppressed due to renal insufficiency. According to Lall et. al. (1997) rise in creatinine value is an indication of renal tabular damage due to Cadmium-induced nephrotoxicity (Kazuo et.al. 1980). Histogram-V. Shows regular increase in serum creatinine value in *H-fossilis* proves that Cadmium is more hephrotoxic to the non-air breathing fishes.



Histogram V : Showing change in creatinine level.

Conclusion:

Going through the above mentioned discussion, it become obvious that heavy metals causes deleterious effects on fish. Although the sub lethal concentration is not enough to the moritility of the fishes but it does affect the growth rate and reproductive activities resulting in the disturbance to whole community and tropic levels of food chain lastly the ecosystem, which reflect its effects on the dwindling of the entire population of the fish.

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