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Periodic Research

Role of Natrolite in remediation of acute lead toxicity in fish

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Abstract

Fish constitute an economically important group of chordates and these are an excellent source of proteins. Fish form a good energy food which is rich in minerals and vitamins. It has been an important food item of man from prehistoric period. Exposure of fish to lead and other metals and accumulation of lead in their tissues cause pathological changes in kidney, gill brain and muscles as observed by many scientist. The most effective method of removing metal toxicity seems to be the application of natural zeolites which are cheaper and found abundantly in nature. Natrolite is a microporus, crystalline solid with well defined structure. Due to lead toxicity the cholesterol contents in kidney and gills of fish is affected. Use of Natural zeolite natrolite reduce thetoxicity in fish.

Keyword: Natrolite, Lead nitrate, Zeolites, Heteropneustes.

Introduction

Fish is a good source of readily digested high quality animal protein. It contains lysine and other amino acids which make it suitable for complimenting the high carbohydrade diets prevailing in many under developed countries and it also provides preformed vitamin A and D . It is also a good source of minerals. Fisheries are endangered by pollution, especially by metal pollution. Natural water bodies are often contaminated by various kinds of waste released by industries and agriculture land. These waste include heavy toxic metals also. Heavy toxic metals can accumulate in aquatic organisms via their diet and become concentrated at levels that are much higher than in the water itself. Lead and cadmium are classified as prevalent toxic metals which tend to be concentrated in environmental systems and humans. Lead is emitted into the biosphere in considerable amounts, owing to its increased industrial use and its applications as a fuel additives. Zeolites are three dimensional, crystlline microporus solids that contain aluminium, silicon and oxygen in their regular framework, cations and water are located in the pores. In the classification of natural zeolites, natrolite is the representative zeolite of the first group, in which the linkage are more numerous in one crystallographic direction than in a plane at right angle to it. It isusually white or colorless but sometimes reddish or yellowish.

Material and methods

For the present study Heteropneustes fossilis locally known as singhan, were collected from local nursery. The average length and weight of experimental fish was 12.5±1 cm and 11.2 ±1 gm respectively. Prior to experimentation fish were acclimatized for 21 days. Fish were fed with commercially available fish food regularly. Acute toxic effect of lead on cholesterol contents in gills and kidney of fish were studied for 7 to 35 days. For cholesterol estimation in the tisue Liebermann-Burchard method (Plummer 1985) was applied. In the present investigation, 96 hrs LC 50 for lead nitrate has been estimated as 105 mg L -1 day -1.

Observation

Table No. 1

Protective action of natural zeolite-natrolite on acute lead toxicity in the kidney of fish *Heteropneustes fossilis* with reference to cholesterol contents (mg/g)

Day of Expo-sure	Control	Treatment Groups		
		Pb (NO3)2	2 Pb(No3)2 + Natrolite	Only Natrolite
7	5.97±0.31	6.40±0.36 7.20%	6.21±0.33 -2.96%	5.98±0.31 0.17%
14	5.98±0.31	6.42±0.36 7.35%	6.24±0.33 -2.80%	5.98±0.31 0.00%
21	6.00±0.31	**6.44**±0.36 7.33%	6.27±0.33 -2.64%	6.01±0.31 0.17%
28	6.03±0.31	6.46±0.36 7.13%	6.30±0.33 -2.47%	6.04±0.31 0.16%
35	6.03±0.31	6.50±0.36 7.79 %	6.32±0.33 -2.77%	6.05±0.31 0.33%

Values are mean SE and % Change.

Table No. 2 : Protective action of natural zeolite-natrolite on acute lead toxicity in the gill of fish *Heteropneustes fossilis* with reference to cholesterol contents (mg/g)

Day of Expo-sure	Control	Treatment Groups		
		Pb (NO3)2	2 Pb(No3)2 + Natrolite	Only Natrolite
7	**5.40±0.30**	**5.76±0.35 +6.66%**	**5.52±0.33 -4.16%**	**5.41±0.30 +0.18%**
14	**5.42±0.30**	**5.79±0.35 +6.82%**	**5.54±0.33 -4.31%**	**5.42±0.30 0.00%**
21	**5.42±0.30**	**5.80±0.35 +7.01%**	**5.55±0.33 -6.03%**	**5.43±0.30 +0.18%**
28	**5.41±0.30**	**5.82±0.35 +7.57%**	**5.57±0.33 -4.29%**	**5.42±0.30 +0.18%**
35	**5.42±0.30**	**5.84±0.35 +7.74%**	**5.58±0.33 -4.45%**	**5.42±0.30 0.00%**

Values are mean SE and % Change.

Result and Discussion

The present study deals with the biochemical changes in vital organs viz kidney and gills of the teleost fish *Heteropneustes fossilis* under the influence of acute exposure of lead nitrate, lead nitrate + natrolite and natrolite only Acute changes were observed in these organs for 35 (at the interval of 7days) days. After 7 days interval in acute study, fish sacrificed, their tissues were removed and processed for biochemical estimation of cholesterol in kidney and gills. For the study of remediation of lead toxicity natural zeolite natrolite was used and it has been observed that natrolite decreases lead toxicity in the fish *H. fossilis*. The observation thus obtained have been summarised in the form of table no. 1 and 2.

The cholestrol contents in kidney and gills of experimental fish of control groups observed almost similar during all the exposure periods. When fish of group II exposed to sublethal concentration of lead nitrate, the cholesterol contents in both experimental tissues found to be increased incomparison to their respective control . The maximum increase in these tissuesreported 7.79 and 7.74 respectively up to 35 days of exposure while theminimum increase observed after 7 days of exposure 7.20 and 6.66 in kidney and gills. When fish of group III exposed to lead nitrate + natrolite, an increase in cholesterol contents has been observed. In the fish of group IV exposed to only natrolite, again increase was observed.

Jia Xiuuing et al ; 2001 studied the effect of heavy metals on the respiration intensity of juvenile ***Misgurunns angwillicandidatus***. They found respiration intensity decreased in them. Revis et al ; 1980; Tarugi et al;1982; leddo et al; 1987, Yogminas et al; 1990 also reported high level of cholesterol due to lead toxicity in animals.

Kargin 1998 studied the concentration of heavy metals in tissues of the fresh water fish ***Copoeta barroisi*** and found the highest concentration in liver and gills. Dhanapakiam et al; 1998 studied the gills of adult ***Channa punctatus*** to effluents of industrial wastes in the Couvery river water, revealed deformities and reported that the industrial and sewage carried by river Cauvery induce considerable chemical stress on fish population . Reduction of food consumption in the presence of heavy metals has been reported by Mckim and Benoit (1971). Deleterious biochemical effects due to lead in fish have also been reported by Spry et al; (1981) and Hodson et al; (1982).

Application of natural zeolites in removal of heavy metals toxicity has been reported by Faghihean et al; 1999. According to Dixon and Web (1964) heavy metal inhibit the activity of a wide range of enzymes of biological system. Brown and Howell (1972) working with zinc and copper, reported that copper exert an inhibitory effect on the oxygen consumption of the whole animal ***Mutilus efulis***. According to Wong et al (1975) complexation of metals by co-ionic linkage with appropriate organic molecules in biological tissues is an important process involved in metal accumulation

by aquatic organism. Respiratory system of fish differ from all other system because damage to gill has immediate impact on the rest of the fish body.Radhakrishnan (1988) observed accumulation of metals in gills of ***Channa punctatus***, *Labeo rohita* and *H fossils* respectively.

Role of zeolite has been studied by Jain et al; (1996). Natrolite is a naturally occuring hydrated aluminosilicate minerals and is composed of symmetrically stocked aluminium and silica tetrahedron (Kesraoni – ouki et al; 1994). The negative charge allows for the absorption of certain positively charge ions. In aqueous solution, the negative charge is generally neutralized by Na +. However Pb is preferentially absorbed to the natrolite matrix. Out of the results obtained in the present study, it can be concluded that application of natural zeolite - natrolite can reduce the lead toxicity in fish.

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