

**Changes in elemental composition of scales of *Channa punctatus* on treatment with mercury****Neeraj Gupta\* and Anish Dua**

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**ABSTRACT**

In the present study different regions in the scales of *Channa punctatus* were investigated for elemental composition to see the impact of mercury on them. Five sublethal concentrations of mercury were used after calculating the LC<sub>50</sub> value which is 1.21mg/L in 96 hours. When focal and lepidontal regions of scales were seen under electron probe analysis (JEOL 8600M), they were composed of four major elements and these are: calcium (Ca); iron (Fe); aluminium (Al); and phosphorus (P). The percent composition of calcium was recorded to be maximum, followed by phosphorus, aluminium and iron. The percent composition of each element upon exposure to mercury was compared to corresponding control and the deviations were observed. When fish was exposed to different sublethal concentrations of mercury for 15d and 30d, an increase was observed in percentage composition of aluminium and phosphorus, whereas reverse trend was noticed for calcium and iron.

**1) INTRODUCTION**

Of all natural resources, water is unarguably the most essential and precious resource that sustains life. Ascertaining its quality is very crucial before its use [1]. Life began in water, and life is nurtured with water. Surface waters are vulnerable to pollution due to their easy accessibility for disposal of wastewaters. Both the anthropogenic influences such as urban, industrial, and agricultural activities, increasing exploitation of water resources as well as natural processes such as precipitation inputs, erosion, and weathering of crust materials degrade surface waters and damage their use for various purposes [2].

Multifold increase in the use of heavy metals leads to pollution in the water body. These metals are stable and persistent environmental contaminants and cannot be degraded or destroyed and have adverse effects in human beings [3, 4] and aquatic life [5]. Mercury is a naturally occurring element, but some 2,000 tons of it enter the global environment each year from human-generated sources such as coal-burning power plants, incinerators and chlorine-producing plants. Deposited onto land or into water, mercury is picked up by microorganisms, which convert some of it to methyl mercury, a highly toxic form that builds up in fish and the animals and people -- that eat those [6].

For the present study mercury in the form of mercuric chloride is used to see its impact on scales elemental composition of *Channa punctatus*.

**2) MATERIAL AND METHOD**

Live specimens of *Channa punctatus* were collected for the present study. Mercury in the form of mercuric chloride was used for investigation. A stock solution of 1 g/L was prepared in normal tap water. From the stock solution measured aliquots of this were added to each experimental tank so as to bring the mercuric chloride concentrations to the required levels i.e. 0.08 mg/L, 0.10 mg/L, 0.25 mg/L, 0.40 mg/L and 0.55 mg/L. Probit analysis was applied on acute toxicity tests in order to calculate LC<sub>50</sub> value for 96 hours according to [7]. In order to quantify the elemental composition of the scales, the cleaned and dried scales were mounted on the glass slide. Samples were sputter coated with Gold (100A°) and specimens were handled only with forceps to prevent contamination of the material. The samples were then subjected to electron probe analysis (JEOL 8600M) at an accelerating voltage of 0.5 to 50KV. The principle involved in that when a high energy electron beam bombards a specimen, characteristic X-rays are produced. Wavelength and intensity of these X-rays can be analyzed to obtain chemical composition qualitatively and quantitatively. This was done with an operating system RSX-11M present in a computer model DEC made LSI-11/23. Electron probe microanalyzer

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extends X-rays spectrochemical analysis in local regions of the order of a micron in size and to quantities less than a microgram. Focal and lepidontal regions of the scales were analyzed with this methodology for their elemental composition and all the results were expressed as mean  $\pm$  S. D. The data was statistically analyzed by using the Students t-test to establish the validity of the investigation.

### 3) RESULTS AND DISCUSSION

In both the focal and lepidontal regions scales of *C. punctatus* are composed of four major elements and these are: calcium (Ca); iron (Fe); aluminium (Al); and phosphorus (P). The percent composition of calcium was recorded to be maximum, followed by phosphorus, aluminium and iron (Table 1) in the control specimens.

**Table 1:** Elemental composition of scales in focal and lepidontal regions of *C. punctatus*

EXPOSURE PERIOD	FOCAL REGION	LEPIDONTAL REGION
Normal scales (control)	Ca > P > Al > Fe	Ca > P > Al > Fe
15 days	Ca > Al > P > Fe	Ca > Al > Fe > P
30 days	Ca > Al > P > Fe	Ca > Al > P > Fe

The percent composition of each element upon exposure to mercury was compared to corresponding control and the deviations were observed in both regions of the scales. When fish was exposed to different sublethal concentrations of mercury for 15d and 30d, an increase was observed in percent composition of aluminium and phosphorus, whereas reverse trend was noticed for calcium and iron (Table 1).

For statistical analysis of the data, the values of standard deviation (SD) and standard error mean (SEM) were calculated. The use of these values is based on the fact that greater the values of SD or SEM, irrespective of increasing or decreasing trend, more is the variability in occurrence of the

degree of lepidontal damages was considered; hence, the methodology described herein is more practicable. On the basis of the values of SD, the following trends in the focal and lepidontal regions have been observed (Table 2).

On the basis of SD and SEM it is concluded that in all the cases calcium is the most affected mineral followed by phosphorus, iron and aluminium. Thus, calcium deposition can be termed as a true pollution indicator in quantitative analysis. This is in accordance with the earlier studies [8, 9].

Percent and the elemental composition of the scale are attributed to the chemistry of the surrounding water in which the fish resides. In the scales of the bony fishes elements like Al, Ca, P, Si, F, Mg, Li, Na, Ca and Bu have been reported by various workers. Cowgill *et al.* [10] reported twenty elements (Ca, Cl, Cr, Co, Cu, F, I, Pb, Mg, Mn, Ni, K, Rb, Se, Si, Na, Sr, S, Ti and Zn) in the scale of *Latimaeria chalumnae* (Smith). However, four major elements, which are studied during the study, are of common occurrence [11, 12].

The present investigations have clearly proved that scale of *C. punctatus* is a good tool to assess the toxicological impact on the fish both qualitatively and quantitatively and can be designated as a successful pollution indicator

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**Table 2:** Percentage composition of major elements in the Focal and Lapidontal regions of scale of *Channa punctatus*

	Calcium				Phosphorus				Aluminium				Iron			
	Focal		Lepidontal		Focal		Lepidontal		Focal		Lepidontal		Focal		Lepidontal	
	15	30	15	30	15	30	15	30	15	30	15	30	15	30	15	30
Control	66.53	62.37	62.17	59.34	19.42	20.23	20.57	24.26	8.53	10.01	8.97	10.32	5.52	7.39	8.29	8.08
Conc. mg/L																
0.80	62.97	62.56	62.08	58.17	20.29	20.87	21.38	25.14	12.10	10.38	9.42	10.02	4.52	6.19	7.12	6.67
0.10	58.74	61.27	60.19	54.97	19.80	21.87	23.02	23.89	13.47	10.75	9.87	14.68	7.99	6.11	6.92	6.46
0.25	63.17	60.36	59.43	51.33	21.40	22.15	23.61	27.94	11.28	11.17	10.93	15.88	4.5	6.32	6.03	4.85
0.40	57.59	59.83	59.11	49.83	23.80	22.87	22.17	28.76	14.74	11.33	12.89	16.92	3.87	5.97	5.80	4.49
0.55	56.83	55.43	58.07	46.03	23.98	24.42	23.05	29.14	16.94	15.72	14.77	17.46	2.25	4.43	4.11	7.37
Mean	60.97	60.47	60.17	53.27	21.24	22.06	22.30	26.52	12.84	11.56	11.14	14.21	4.71	6.06	6.37	6.32
SD	3.8	2.6	2.6	5.13	2.01	1.49	1.15	2.85	2.09	2.09	2.25	3.31	1.92	0.94	1.41	1.40
SEM	1.7	1.16	0.71	2.3	0.90	0.64	0.51	1.27	1.3	0.93	1.01	1.43	0.86	0.42	0.63	0.62

specific elemental due to damage done by the toxicant. This type of quantitative comparison was not possible when the

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