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Changes in serum biochemistry of fish, *Channa punctatus* in response to nickel toxicity

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Abstract
The present investigation has been designed to study the effect of sub lethal concentrations of Nickel on the serum metabolites of *Channa punctatus* after exposure to 45 days. The present study shows that serum metabolites such as glucose and protein were significantly decreased while lipid was significantly increased. Thus, the result provides an overview of the manipulation of fish, *Channa punctatus* as a biomarker of heavy metals through alternation in serum biochemical parameters.

Keywords: *Channa punctatus*, Nickel, metabolites

Introduction
Freshwater is highly susceptible to pollution since it acts as a direct sink for the consequences of anthropogenic activities which are always accompanied with the danger of criminal negligence or accidental discharges (Sachar and Raina, 2014) [11]. Metals are of particular concern due to their non-degradable and persistent nature therefore could cause negative effects to the inhabiting fauna and flora (Javed *et al*., 2016) [5]. Nickel (Ni) is an essential element at low concentration for living organisms but it is highly toxic at higher concentration. It is released by industries that use Ni, convert scrap or new Ni into Ni compounds or alloys and during Ni mining. These industries may also release Ni in wastewater (Hassan *et al*., 2020) [4].
The fishes are considered a best indicator of aquatic pollution because they are most sensitive of all the aquatic animals (Sinha, 2017 & 2019) [13, 14]. Heavy metal exposure in the aquatic environment causes bioaccumulation in aquatic organisms and can lead to haematological, physiological and metabolic disorders (Verma and Prakash, 2019a, 2019b & 2020; Prakash and Verma, 2019b, 2020) [8, 9, 10].
The accumulation of heavy metal becomes hazardous to the aquatic organisms and to surrounding human population because the fishes are the most important factors of food chain which have great nutritive value and source of all essential amino acids. Biomolecules are the most assessable body contents for checking the toxicity of any chemicals. Any alteration in biochemical parameters can result in serious outcomes in the form of various diseases in both the animal and its consumers.
Analysis of serum biochemical parameters especially useful to identify target organs of toxicity as well as the general health status of animals, and is advocated to provide early signs of critical modifications in stressed organisms. Hence, the present investigation is aimed to study the changes in serum biochemical parameters of nickel exposed *Channa punctatus*.

Materials and Methods
The healthy *Channa punctatus* ranging from 8.0-9.0 cm in length and weighting 9.0-10.0 gm were collected from local water body and washed with 1% solution of $KMnO_4$ for five minute and then transferred to the plastic jar containing 50L dechlorinated tap water for acclimatization. Fish were acclimated to laboratory conditions for 10 days. Based on 96 LC_{50}, fishes were exposed to sublethal concentrations (5.0 mg/l) for treated and control period of 45 days. A control group was maintained in an identical environment. The fishes were regularly fed with commercial feed and the medium was changed daily to remove faeces and food remnants.

Blood samples of these fishes were collected from caudal vein in the glass tubes and centrifuged at 3500 rpm for 10 minutes. The serum metabolites such as glucose, protein andlipid. by Mendel *et al*. (1954) [6], Lawery's method as described by David (1992) [2] and Barnes and Blackstock (1973) [1] method, respectively.

Results and Discussion

Changes in the blood biochemical values often reflect alteration of physiological state of fish. Result of the quantitative estimation of serum metabolites such as glucose, total protein, and triglycerides in the control and nickel exposed fish, *Channa punctatus*, are presented in Table 1.

The serum glucose levels were significantly decreased in nickel exposed fish, *Channa punctatus* as compared to control groups (Table1). The fall in the glucose content (hypoglycemia) in the serum indicate its rapid utilization by the fish as a consequence of metabolic toxic stress. Similar decrease in serum glucose level has also been reported by Saxena and Chauhan (1994) in copper induced *Heteropneustes fossilis* and by Singh *et al*. (2010) [12] in phorate induced *Channa punctatus*.

Table 1: Effects of sub lethal concentrations of Nickel (5.0 mg/l) on serum metabolites of *Channa punctatus* at different period of exposure (N=6).

Serum Biochemical Parameters	Group	Exposure periods in days		
		15	30	45
Glucose (mg/dl)	Control	120.0±1.11	121.0±0.98	120.5±1.02
	Exposed	92.6±0.86	86.8±0.69*	76.7±0.88**
Total Protein (mg/dl)	Control	3.07±0.64	3.05±0.57	3.06±0.62
	Exposed	2.12±0.65*	1.84±0.72**	1.70±0.58**
Total Lipid (mg/dl)	Control	88.12±1.12	87.98±1.23	88.13±0.78
	Exposed	115.8±0.54	138.2±0.85*	168.5±2.11**

*Significant at $P< 0.05$; ** significant at $P< 0.01$.

Proteins are highly sensitive to heavy metals and one of the earliest indicators of its toxicity. In the present study significant decline in the serum proteins contents was observed in nickel exposed fish, *Channa punctatus* as compared to control groups (Table1). Similar decrease in serum protein level has also been reported by Talas *et al*. (2012) [16] in arsenic exposed *Cyprinus carpio* and by Devi (1982) [3] in endosulfan exposed *Channa punctatus.* This hypoproteinemia in the present study can be attributed to the enhanced proteolysis. Proteolysis, seems to offer a physiological mechanism in a bid to provide energy to cope up with the stressful situation caused by metal toxicity (Srivastava and Prakash, 2018) [15].

Lipid represent the major energy reserve in the fish. In the present study serum lipid undergo significant increase in nickel exposed fish, *Channa punctatus* when compared to control (Table 1). Similar increase in serum triglyceride level has also been reported by Talas *et al*. (2012) [16] in arsenic exposed *Cyprinus carpio* and by Devi (1982) [3] in endosulfan exposed *Channa punctatus.* Srivastava and Prakash (2018) [15] pointed that various lipolytic enzymes which convert triglycerides into fatty acids and glycerol may be released into blood due to the degeneration of liver cells leaving triglycerides unprocessed. Thus, it seems that reduced rate of lypolysis ultimately results in the elevated serum triglycerides levels. Thus it can be concluded that aquatic pollutant induced an energy crisis and altered carbohydrate, protein and lipid metabolism by exerting their manifestation in fishes that are important in their physiological activities, survival, growth and reproduction (Prakash and Verma, 2018) [7]. Thus examination of biochemical parameters like glucose, protein and lipid can be useful as a diagnostic tool in fish toxicology to identify their general health status and target organs affected by toxicant.

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