Research Article

SERUM BIOCHEMICAL ALTERATIONS IN FISH *Mugil cephalus* COLLECTED FROM UPPANAR RIVER, CUDDALORE, TAMILNADU, INDIA

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Abstract

River is an important ecosystem contributes significantly to living organisms. Nowadays, due to pollution from different sources like industries, agricultural fields, anthropogenic activity, aquatic ecosystems are under pressure. In the current investigation, alteration in the serum biochemical parameters such as glucose, protein and cholesterol in fish *Mugil cephalus* collected from three different stations viz., Station I (Poondiyankuppam), Station II (Sangolikuppam) and Station III (Kudikadu) in Uppanar river. The observed serum biochemical data showed a significant decrease (p<0.05) when compared to other two stations (II & I). These could be attributed to the discharge of untreated SIPCOT effluents loaded with heavy metals, pesticides and other unidentified pollutants. Hence, it was concluded that the Uppanar river has been polluted from moderate to high level and is necessary to take effective measures to protect this wonderful ecosystem.

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1. Introduction

Water is an essential resource for agriculture, manufacturing and other human activities to lead life. Fresh water resources are deteriorating day – by - day at a faster rate which is a frightening global problem at present (Mahananda *et al.*, 2010). Almost 70 % of India’s surface water resources have been contaminated by biological, organic and inorganic pollutants (Joseph and Jacob, 2010; Agarwal and Saxena, 2011). The addition of various kinds of pollutants and nutrients through the sewage, industrial effluents, agricultural runoff etc, into the river bodies brings about a series of changes in the physicochemical characteristics of water (Singh *et al.*, 2010; Mullai *et al.*, 2012) and causes harmful effects to fishes, plants, human and other animal health. Fish are considered to act as suitable biomonitors for environmental pollution (Padmini *et al.*, 2004). Once the surface water is contaminated, its quality cannot be restored by stopping the pollutants from its source. Hence, continuous monitoring of the water quality becomes crucial in order to protect it (Yisa and Jimoh, 2010). Uppanar River is one of the highly polluted aquatic ecosystems situated in Cuddalore District, Tamilnadu, India due to heavy industrialization surrounding this site poses serious threat to its inhabitants. Serum biochemical data are of immense importance in monitoring the health status of aquatic organisms,

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especially in fisheries management programs. Hence, the present paper focuses on the responses of the fish *Mugil cephalus* with reference to its serum biochemical changes during their exposure to industrial effluents loaded with various kinds of pollutants that are discharged into the Uppanar River.

2. Materials and Methods

Study area description

The present study area River Uppanar is located in the Cuddalore District of Tamilnadu, India. The study area has been divided into 3 different stations viz., Station I (Poondiyankuppam), Station II (Sangolikuppam) and Station III (Kudikadu) based on the distance from the SIPCOT industrial estate.

Station I – Station I is an industrial free zone which is located 4 km away from station II and there is no agricultural land and human residents.

Station II – This station lies nearer the mouth of the estuary, which is nearly 4 km away from station III, and in close proximity to the fishing harbour.

Station III – It is situated nearer to SIPCOT, where the industrial units are discharging their effluents. Municipal wastes and domestic sewage from the nearby Cuddalore town and coconut retting effluents are also released here.

Fish sample collection

Fish *M. cephalus* was collected from three different stations at Uppanar estuary during summer season in the year of 2015 and they were immediately transferred to ice box for further study.

Collection of blood samples

Approximately 0.05 ml of blood was collected in a Vacutainer fitted with a 20-gauge needle by caudal vein puncture from fish. The temperature of the samples was kept at 4 °C; EDTA and an aqueous solution of heparin were used as anticoagulants (Rehulka, 2000). Glucose levels were determined by enzymatic UV test, which has been described by Schmidt (1961). Enzymatic hexokinase catalyzes the reaction between glucose and adenosine triphosphate to form glucose-6-phosphate and adenosine diphosphate. In the presence of NAD, the enzyme glucose-6-phosphate dehydrogenase oxidizes glucose – 6 - phosphate to 6 - phosphogluconate. The increase in NADH concentration is directly proportional to glucose concentration and can be measured spectrophotometrically at 340 nm.

Total protein was measured using colorimetric test. Operation of the kit was based on the method described by Weichselbaum (1946). Divalent copper reacts in alkaline solution with protein peptide bonds to form the characteristic purple - colored biuret complex. Colour intensity is directly proportional to protein concentration, which can be determined photometrically.

Cholesterol levels were determined by enzymatic colorimetric test (Abell *et al*., 1952). In this method, cholesterol esters are hydrolyzed to free cholesterol by cholesterol esterase. Free cholesterol is then oxidized by cholesterol oxidase to produce hydrogen peroxide, which forms a red chromophore when combined with 4 - aminophenazone and phenol. Formation of this chromophore was measured at 520 nm at 37 °C and was directly proportional to the cholesterol concentration of the sample.

Statistical Analysis

All quantitative measurements were expressed as means ± SD for control and experimental animals. The data were analyzed using one way analysis of variance (ANOVA) on SPSS/PC* (statistical package for personal computer) Version 15.0 and the group means were compared by Tukey’s Multiple Range Test (TMRT). The results were considered statistically significant if the *p* value is less than 0.05.

3. Results and Discussions

Glucose

The serum glucose level in fish *M. cephalus* found to be varied in different studied stations of Uppanar river. In the current report the serum glucose levels showed a decreasing trend in Station II and in Station III than the Station I. In
Station I (Poondiyankuppam), serum glucose level was observed as 110.8 ± 0.93 mg/dl further it was decreased to 99.8 ± 0.75 mg/gl in Station II (Sangolikuppam), followed by 55.75 ± 0.54 mg/dl in station III (Kudikadu). Since, carbohydrates supply an immediate energy source during stress the reduction in the glucose level could be attributed to the utilization of stored glycogen to meet out the energy demand or chronic exposure (David et al., 2005; Zutshi et al., 2010; Javed and Usmani, 2013; Javed and Usmani, 2014). Among the stations studied, the serum glucose level was found to be reduced significantly (P<0.05) in S III (Kudikadu) than the other two stations. These could be due to the discharge of high amount of SIPCOT effluents loaded with various kinds of pollutants in S III. Similar to our present report depletion of the glycogen content in the liver and muscle was also observed in fish Mystus cavasius exposed to electroplating industrial effluent (Palanisamy et al., 2011), Channa punctatus exposed to distillery effluent (Maruthi and Subba Rao, 2000). The results of present investigation showed that the heavy metals and other toxicants in the effluents released from SIPCOT industries could be attributed to the depletion of the glycogen reserves in fish and invertebrates by affecting the enzymes activities that play a role in the carbohydrate metabolism.

### Cholesterol

Changes in the cholesterol level in the serum was found to be varied among the different stations, higher level was observed as 70.07 ± 2.00 mg/dl in Station I (Poondiyankuppam) followed by 60.83 ± 1.75 mg/dl in Station II (Sangolikuppam) whereas lower cholesterol level of 50.92 ± 2.06 mg/dl was observed in Station III (Kudikadu). Among the stations studied, variation in the cholesterol level in S III found to be statistically significant (P<0.05) when compare to other stations (Figure - 1). Cholesterol is an indispensable structural constituent of cell membranes as well as the outer layer of plasma lipoproteins and is the precursor of all steroid hormones (Yang and Chen, 2003). In the present study, metals and other toxicants present in the SIPCOT industrial effluents caused depletion in serum cholesterol level, indicating hypcholesteremia. This may be due to the inhibitory effects of metals on cholesterol synthesis (Dutta and Haghighi, 1986). It is also suggested that hypocholesteremia observed due to pesticides from agricultural runoff in the present study area, hydropic changes in tissues and that the bio accumulated pesticide inhibited the conversion of esterified cholesterol to free cholesterol attributed to the depletion of serum cholesterol (Agrahari et al., 2007). Decreased serum cholesterol levels were reported in Lepomis macrochirus (Dutta and Haghighi, 1986) and Oreochromis mossambicus (Ruparelia et al., 1989) in response to mercury and lead exposure, respectively.

### Protein

The serum protein level in the present investigation showed a decreasing trend. Change in the serum protein level in M. cephalus collected from selected stations of Uppanar River showed variation, higher serum protein level was observed as 16.10 ± 1.35 mg/dl in Station I (Poondiyankuppam) followed by 10.50 ± 1.29 mg/dl in Station II (Sangolikuppam) whereas depleted serum protein level 5.80 ± 1.51 mg/dl was observed in Station III (Kudikadu). Among the stations studied, variation in the serum protein level in S III was found statistically significant at P<0.05 when compare to other stations (Figure - 2).

The decrement of total protein in S III was found to be higher and this may be due to the heavy metals and other pesticides in the SIPCOT effluents released into station III. These heavy metals disturb the synthesis of RNA, which inhibit the protein metabolism. The pesticides from agricultural runoff drained into the Uppanar River induced biochemical changes in fishes resulted in drastic decrease in the protein content. Under conditions of stress many organisms will mobilize proteins as an energy source via oxidation of amino acids. The depletion in total protein content may be due to augmented proteolysis and possible utilization of their product for metabolic purposes (Ravinder et al., 1985). On the other hand decline in protein content may be related to impaired food intake, increased energy cost of homeostasis,
tissue repair and detoxification mechanism during stress (Neff, 1985; Dalela et al., 1981) have found depletion in serum protein level after exposure of pesticide on Mystus vittatus and also stated this may be due to kidney disorder (Albuminuria) or impaired protein synthesis as a result of liver disorder. Shaikh et al. (2014) have also reported the decrease in serum protein level on Channa punctatus after exposure. In the present investigation, reduction in the serum total protein may also be attributed to intensive proteolysis which contributes to the increase in the free amino acids to be fed into TCA cycle as keto acids.

Figure – 1: Map of the study area

Figure - 2: Changes in serum glucose, cholesterol and protein levels of fish M. cephalus collected from different stations of Uppanar river

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4. Conclusions

Serum biochemical parameters are the important biomarker to assess the health condition of fish as well as environmental pollution. Based on the current investigation, the analysed biochemical alteration showed significant variations. The results revealed that station III was found to be highly polluted than station II and I. These changes could be due to indiscriminate discharge of SIPCOT effluents and other hazardous wastes into Uppanar River. Hence it is recommended that the effluents should be treated properly before being discharged from industries.

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5. References


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