

Available online at [GSC Online Press Directory](http://www.gsonlinepress.com)

GSC Biological and Pharmaceutical Sciences

e-ISSN: 2581-3250, CODEN (USA): GBPSC2

Journal homepage: <https://www.gsonlinepress.com/journals/gscbps>

(RESEARCH ARTICLE)



## Impact of polycyclic aromatic hydrocarbon effluent on the enzyme activity in blood serum of freshwater food fish *Cirrhinus mrigala*

Kamaraj C and Thamilmani K \*

PG and Research Department of Zoology, Arignar Anna Government Arts College, Musiri, Tiruchirappalli – 621 211, Tamil Nadu, South India.

Publication history: Received on 15 July 2018; revised on 10 August 2018; accepted on 18 August 2018

Article DOI: <https://doi.org/10.30574/gscbps.2018.4.3.0066>

### Abstract

The purpose of this study was to estimate the acute toxicity of polycyclic aromatic hydrocarbon (PAH) effluent on *Cirrhinus mrigala* and to evaluate the lethal levels. The 120 hrs median lethal concentration of polycyclic aromatic hydrocarbon (PAH) effluent were found to be 20ppt for *Cirrhinus mrigala*. Further experiments were proceeded with sub lethal concentration of (1/10<sup>th</sup> conc. of LC<sub>50</sub>) polycyclic aromatic hydrocarbon (PAH) effluent which were evaluated from the LC<sub>50</sub> value. After treatment the fishes were reared in ideal condition, then sacrificed dissected at different predetermined interval during the accumulation period, (i.e.) 1<sup>st</sup> day to 20<sup>th</sup> day, during the depuration period from 1<sup>st</sup> day to 15<sup>th</sup> day for *Cirrhinus mrigala* in polycyclic aromatic hydrocarbon (PAH) effluent treatment for assay studies. The enzyme activity studies carried out under sub lethal (1/10<sup>th</sup> conc. of LC<sub>50</sub>) in Blood Serum. The present study indicates that oil effluent induced alterations in the enzymatic activities of the freshwater food fish both at acute and sub-lethal concentrations. These alterations can be considered as a tool for biomonitoring of pharmaceutical drug substances in the aquatic environment. The present work also indicates that oil effluent causes considerable alterations in enzymes activities and is likely to induce tissue damage in *Cirrhinus mrigala*. Therefore, this effluent should be handling with care and prevent its entrance into aquatic environment.

**Keywords:** Polycyclic aromatic hydrocarbon; *Cirrhinus mrigala*; SGOT; SGPT

### 1. Introduction

Fish is very important to man as it is one of the most readily available and valuable source of high grade and cheap protein, which is easily digestible. *Catla catla* is one of the fresh water major Indian carp. It is highly powered food fish with good market demand [1]. Fish as a bio-indicator species can play an important role in the monitoring of water pollution, as they respond with great sensitivity to changes in the aquatic environment [2].

The natural aquatic systems were the ultimate recipient of the pollutants [3]. Aquatic ecosystems were contaminated with a wide range of pollutants has become a matter of concern over the last few decades [4]. The accumulation and persistence of pollutants by contaminants and toxicants, released from weathering of geological matrix, or from anthropogenic sources, such as industrial effluents and mining wastes [5] represents a major threat to the biological life. Aquatic animals were the key stone species in many ecosystems [6]. Fishes are one of the most widely distributed organisms in the aquatic ecosystem and reflect the biological effects of environmental pollution. The contamination of aquatic system was attracted the attention of researchers all over the world [7].

\*Corresponding author

E-mail address: [kthamilmani78@gmail.com](mailto:kthamilmani78@gmail.com)

Aquatic pollution is one of the current global environmental issues. Due to rapid industrialization and unplanned urbanization many rivers in India are experiencing complicated problems of pollution. It causes reduction in the quality of water. Thus, water bodies are frequently stores for a large variety of xenobiotics which cause the biochemical alternations in fish. Population explosion, rapid industrialization and consequent anthropogenic stress on the environment have resulted in alarming levels of pollution and environmental degradation, particularly of the aquatic environment. The major sources of water pollution are domestic, agricultural and industrial wastes which are discharged into natural water bodies [8].

Enzymes play significant role in food utilization and metabolism. But this system may get altered under the stress of pollutants. High conductivity and low dissolved oxygen usually associated with heavy metals and industrial effluent will alter the activity of hydrolytic enzymes like esterases and transaminases of the fish exposed to them [9]. The proteolytic enzymes participate in the breakdown of protein molecules into amino acids and these amino acids are in turn oxidized to give energy for body function [10]. Enzymes are exceedingly efficient and very specific in terms of nature of reaction catalyzed and the substrate utilized.

SGPT is responsible for synthesis and deamination of amino acids during stressful conditions in order to cope with high energy demands. In addition, it can also be used to evaluate environmental stress because environmental stress caused by toxicants or drugs can damage the liver, causing this enzyme to be affected. So we can say that the concentration of this enzyme can be used to detect liver health and normal functioning [11]. Dephosphorylation is a process of removing the phosphate group from any molecule such as nucleotide, proteins, etc., and this dephosphorylation is done in the presence of alkaline phosphatase enzyme. This enzyme also plays an important role in mineralizing the skeletal system of animals, thus concluded that alkaline phosphatase plays a role in the growth and development of bones and teeth [12]. The aim of present study is to check out the alterations of transaminase such as serum glutamate oxaloacetate transaminase (SGOT) and serum glutamate pyruvate transaminase (SGPT) activity in blood samples of the fresh water fish *Cirrhinus mrigala* exposed to polycyclic aromatic hydrocarbon effluent.

## 2. Material and methods

### 2.1. Collection of experimental animal

The fish, *Cirrhinus mrigala* (Length  $9.3 \pm 0.002$ cm; Weight  $10.5 \pm 0.003$  g) fresh water food fish were segregated and procured from Karanthai (Golden Fish Farm) farm, Thanjavur, Tamil Nadu, India and were transported in aerated polythene bags to the laboratory. The fishes were acclimatized to lab condition for 3 days before treatment with polycyclic aromatic hydrocarbon (PAHs) effluent.

### 2.2. Toxicity test

The purpose of this study was to test the toxicity of polycyclic aromatic hydrocarbon (PAHs) effluent on *Cirrhinus mrigala* and to evaluate the lethal levels of polycyclic aromatic hydrocarbon effluent. At first tentative experiment were conducted to fix the minimum concentration of polycyclic aromatic hydrocarbon effluent to obtain maximum mortality for *Cirrhinus mrigala* over 120 hours duration. After confirming the minimum concentration, identified size of *Cirrhinus mrigala* were placed in different tubs (each group consists of 6 animals in 10 liter capacity plastic tubs) and exposed to different concentration of polycyclic aromatic hydrocarbon effluent which ranges from 10 ppt (parts per thousand) – 30 ppt at an interval of 5 ppt for *Cirrhinus mrigala* for a period of 120 hour. In addition to that a control was also maintained simultaneously.

### 2.3. Effect on SGOT and SGPT

The enzyme activities carried out under sub lethal ( $1/10^{\text{th}}$  conc. of  $LC_{50}$ ) concentration in blood serum. Serum glutamate oxaloacetate transaminase (SGOT) and Serum glutamate pyruvate transaminase (SGPT) in the serum were estimated by clinical kit provided by Biosystems Diagnostics Pvt. Ltd., Tamil Nadu (India).

## 3. Results

### 3.1. Toxicity

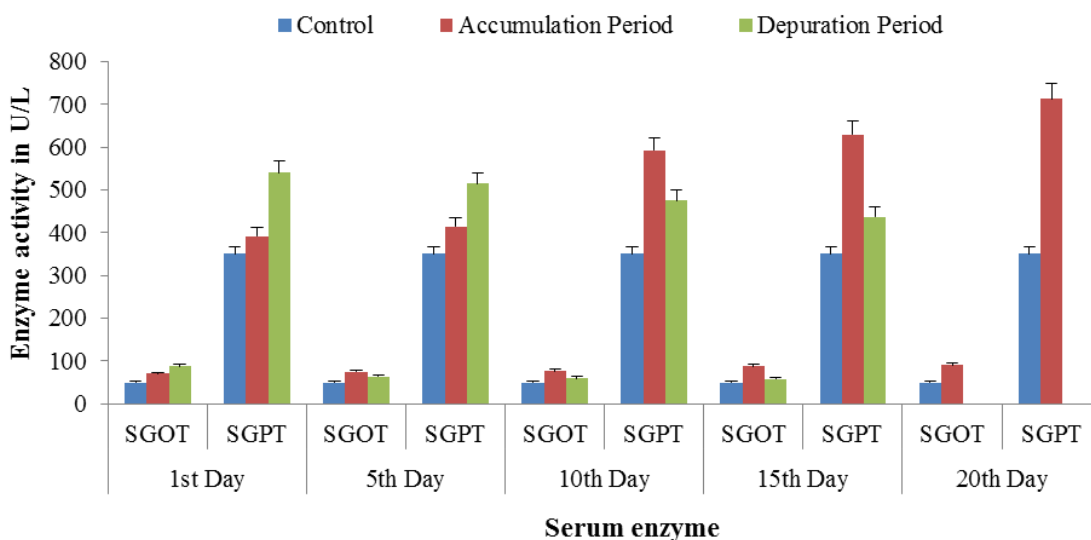
The 120 hrs median lethal concentration of polycyclic aromatic hydrocarbon effluent on *Cirrhinus mrigala* was 20 ppt. During the experimental period the fishes were restless aggressive and have the tendency to leap out of the tubs (struggle for existence). This may be due to the suffocation out of oxygen deficiency. Secretion of mucus in the gill

chamber should the lesions in gills of fishes. The 120 hrs median lethal concentration of polycyclic aromatic hydrocarbon effluent were found to be 20 ppt for *Cirrhinus mrigala*.

### 3.2. Effect on serum enzymes

#### 3.2.1. Serum glutamate oxaloacetate transaminase (SGOT)

The figure 1 represents the level of SGOT in response to polycyclic aromatic hydrocarbon effluent in serum of *Cirrhinus mrigala*. The mean values of control were found to be  $50 \pm 5$  U/L. During the accumulation period, the mean values were found to be increased significantly from 1<sup>st</sup> day ( $70 \pm 3$  U/L) to 20<sup>th</sup> day ( $91 \pm 1$  U/L). During the depuration period, the mean values were found to be decreased significantly from 1<sup>st</sup> day ( $87.33 \pm 1.15$  U/L) to 15<sup>th</sup> day ( $58 \pm 2$  U/L).



**Figure 1** The level of SGOT and SGPT in the blood serum of *Cirrhinus mrigala* during accumulation and depuration period of sub lethal concentration of polycyclic aromatic hydrocarbon effluent

#### 3.2.2. Serum glutamate pyruvate transaminase (SGPT)

The figure 1 represents the level of SGPT in response to polycyclic aromatic hydrocarbon effluent in serum of *Cirrhinus mrigala*. The mean values of control were found to be  $350 \pm 2$  U/L. During the accumulation period, the mean values were found to be increased significantly from 1<sup>st</sup> day ( $392 \pm 2$  U/L) to 20<sup>th</sup> day ( $712 \pm 2$  U/L). During the depuration period, the mean values were found to be decreased significantly from 1<sup>st</sup> day ( $540 \pm 2$  U/L) to 15<sup>th</sup> day ( $437 \pm 2$  U/L).

## 4. Discussion

The 120 hrs median lethal concentration of polycyclic aromatic hydrocarbon effluent were found to be 20ppt for *Cirrhinus mrigala*. The fishes exposed to sub-lethal concentration (1/10<sup>th</sup> conc. of LC<sub>50</sub>) of polycyclic aromatic hydrocarbon effluent. Gradual increased activity of SGOT and SGPT is observed in the blood samples ( $70 \pm 3$  U/L at 1<sup>st</sup> day to  $91 \pm 1$  U/L at 20<sup>th</sup> day for SGOT and  $392 \pm 2$  U/L at 1<sup>st</sup> day to  $712 \pm 2$  U/L at 20<sup>th</sup> day for SGPT) respectively. Similarly, Ghorpade and Mehta have reported an increase of GPT and GOT activity in muscle and liver after exposure to diethyl phthalate (DEP) on a freshwater fish, *Cirrhinus mrigala*. [13]

The accumulation period of the sub lethal concentration of (1/10<sup>th</sup> conc. of LC<sub>50</sub>) of polycyclic aromatic hydrocarbon effluent exposed to *Cirrhinus mrigala* gradually increased activity of SGOT and SGPT the mean values of  $70 \pm 3$  U/L to  $91 \pm 1$  U/L.  $392 \pm 2$  U/L to  $712 \pm 2$  U/L at 1<sup>st</sup> day to 20<sup>th</sup> day respectively. During the depuration period, the gradually degraded of SGOT and SGPT level observed in blood sample the mean value of  $87.33 \pm 1.15$  U/L to  $58 \pm 2$  U/L.  $540 \pm 2$  U/L to  $437 \pm 2$  U/L at 1<sup>st</sup> day to 15<sup>th</sup> day respectively.

An increase in SGOT and SGPT has been reported in *Cyprinus carpio* [14], *Sparus aurata* [15], *Carassius auratus gibelio* [16] and *Cyprinus carpio* [17] after exposures to various metals. Mathan opined that an increase these enzymes may have resulted from tissue damage and increased synthesis of the enzymes to defend against stress [14]. Antonella and

Landriscina also suggested that cadmium alters hepatocyte cell membrane structure and concomitantly induces changes in mitochondrial membranes resulting in elevation of these enzymes [15].

According to Sadhu the enzyme activity increased with the increasing fish size. The inhibition of SGOT and SGPT activities observed in the serum of *Channa striatus*, exposed to malathion [19]. Winkaler observed that the increase in SGOT and SGPT level in fish *Prochloodus lineatus* exposed to pollutants [20].

The increase in GOT and GPT activity may also be due to decrease in metabolic activity, disruption of enzyme system by blocking active sites and tissue damage. Similar observations were made by Bhatnagar and Tyagi [21]. Saqib also reported high levels of GOT and GPT was found in tissues with higher accumulation of pesticide residues [22].

Similar increase in the activities of SGOT and SGPT was reported by Sastry and Sharma in *Channa punctatus* and *Aphanius dispar* in exposed acutely and chronically to mercury [23]. It is also reported that stimulation of transaminase activity in kidney and brain of *Notopterus notopterus* after exposure to cadmium [24].

---

## 5. Conclusion

The 120 hrs median lethal concentration (LC<sub>50</sub>) of polycyclic aromatic hydrocarbon effluent on *Cirrhinus mrigala* was 20 ppt. The level of SGOT and SGPT of serum samples were found to be increased significantly during the accumulation of (1/10<sup>th</sup> and 1/20<sup>th</sup> Conc. of LC<sub>50</sub>) sub lethal concentration and it was regained in all serum samples during the depuration period (35 days) significantly. Therefore the present work indicates that oil effluent causes considerable alterations in enzymes activities and is likely to induce tissue damage in *Cirrhinus mrigala*. Therefore, this effluent should be handling with care and prevent its entrance into aquatic environment.

---

## Compliance with ethical standards

### Acknowledgments

The Authors express their deep sense of gratitude to the Principal of Arignar Anna Govt. Arts College, Musiri and the Head of the Department of Zoology, Arignar Anna Govt. Arts College, Musiri for providing laboratory facilities to carry out this work. The authors are also thankful to the University Grants Commission, New Delhi, India for supporting the work in the form of major research project.

### Disclosure of conflict of interest

The authors declare that they have no conflict of interests. Kamaraj conducted the experiments, including statistical analyses and mainly wrote the manuscript. Thamilmani participated in the writing of the manuscript, and management of the laboratory.

---

## References

- [1] Jhingram, VG. (1991). Fish and Fisheries of India, 3rd edition Hindustan Publishing Corp. (India) New Delhi 727.
- [2] Smolowitz, RM, Hahn ME and Stegemann JJ. (1991). Immunochemical localization of cytochrome P450 1A induced by 3,3,4,4, tetrachlorobiphenyl and 2, 3, 7, 8 tertrachlorobenzofuran in liver and extra hepatic tissues of the teleost, *Stenotomus chrysops*. Drug Metabolism & Disposition, 19, 113-123.
- [3] Fleeger, JW, Carman KR and Nisbet RM. (2003). Indirect effects of contaminants in aquatic ecosystems. Science of the Total Environment, 317, 207-233.
- [4] Vutukuru, SS, Chintada S, Madhavi KR, Rao JV and Anjaneyulu Y. (2005). Acute effects of copper on superoxide dismutase, catalase and lipid peroxidation in the freshwater teleost fish, *Esomus danricus*. Fish Physiology and Biochemistry, 32(3), 221-229.
- [5] Ebrahimpour, M and Mushrifah I. (2010). Seasonal Variation of Cadmium, Copper and Lead Concentrations in Fish from a Freshwater Lake. Biological Trace Element Research, 1-3, 191-201.
- [6] Lonsdale, DJ, Cerrato RM, Holland R, Mass A, Holt L and Schaffner RA. (2009). Influence of suspension-feeding bivalves on the pelagic food webs of shallow, coastal embayments. Aquatic Biology, 6, 263-279.

- [7] Dutta HM and Dalal R. (2008). The effect of endosulfan on the ovary of bluegill sunfish: a histopathological study (*Lepomis macrochirus*). International Journal of Environmental Research, 2, 215-224.
- [8] De AK. (1996). Environmental Chemistry, 3<sup>rd</sup> edition, New Age International Pvt. Ltd. New Delhi.
- [9] Ambrose T, Vincent S and Cyril L. (1994). Susceptibility of the freshwater fish *Gambusia affinis* (Baird and Girard), *Sarotherodon mossambicus* (Peters) and *Cirrhinus mrigala* (Ham) to Zinc toxicity. Indian Journal of Environment and Toxicology, 4, 29-31.
- [10] Saravanan, TS, Aneez Mohamed M and Harikrishnan R. (2000). Studies on the chronic effects of Endosulfan on blood and liver of *Oreochromis mossambicus*. J Ecol Res Biocon, 1, 24-27.
- [11] Wang CS, Chang Ting-Tsung, Yao, Weijen, Wang, Shan-Tair, Chou and Pesus. (2012). Impact of increasing alanine amino transferase levels within normal range on incident diabetes. Journal of the Formosan Medical Association, 111, 201.
- [12] Dong X, Zhu L, Wang J, Xie H, Hou X and Jia W. (2009). Effects of atrazine on cytochrome P450 enzymes of zebrafish (*Danio rerio*). Chemosphere, 77, 404.
- [13] Ghorpade, N., Mehta, V., Khare, M., Sinkar, P, Krishnan, S and Rao, C. V. (2002). Toxicity study of diethyl phthalate on freshwater fish *Cirrhina mrigala*. Ecotoxicol. Environ. Saf, 53, 255–258.
- [14] Mathan R. (2006). Studies on the impact of heavy metal cadmium on certain enzymes in a freshwater teleost fish, *Cyprinus carpio*. Toxicology Letters, 164, 157-161.
- [15] Antonella, V and Landriscina C. (1999). Changes in liver enzyme activity in the teleost *Sparus aurata* in responses to cadmium intoxication. Ecotoxicology and Environmental Safety, 43, 111-116.
- [16] Zikic RV, Stajn AS, Pavlovic SZ, Ognjanovic BI and Saicic ZS. (2001). Activities of superoxide dismutase and catalase in erythrocytes and plasma transaminases of goldfish (*Carassius auratus gibelio* Bloch.) exposed to cadmium. Physiological Research, 50, 105-111.
- [17] De la Torre FR, Salibian A and Ferrari L. (2000). Biomarkers assessment in juvenile *Cyprinus carpio* exposed to waterborne cadmium. Environmental Pollution, 109, 277-282.
- [18] Velmurugan, B, Ambrose T and Selvanayagam M. (2006). Genotoxic evaluation of lambda cyhalothrin in *Mystus gulio*. Journal of Environmental Biology, 27, 247-250.
- [19] Sadhu, KA, Chowdhury and Mukhopadhyay. (1985). Relationship between serum enzymes, histological features and enzymes in hepato pancreas after sub lethal exposure to malathion and phophamidon in the murrel *Channa striatus* (B.L.). International Journal of Environmental Studies, 24, 35-41.
- [20] Winkaler, EU, Santos TRM, Machado-Neto JG and Martinez CBR. (2007). Acute lethal and sublethal effects of neem leaf extracts on the neotropical freshwater fish *Prochilodus lineatus*. Comparative Biochemistry and Physiology, 145, 236-244.
- [21] Bhatnagar, MC and Tyagi M. (1995). Pyrethroid induced alternations in transaminases in liver and muscle of *Clarias batrachus* (Linn). Proceedings of the Academy of Environmental Biology, 4(2), 251-253.
- [22] Saqib, TA, Naqvi SN, Siddiqui PA and Azmi MA. (2005). Detection of pesticide residues in muscles, liver and fat of 3 species of *Labeo rohita* found in Kalri and Haleji lakes. Journal of Environmental Biology, 26, 433-438.
- [23] Sastry, KV and Sharma K. (1980). Mercury induced haematological and biochemical anomalies in Ophiocephalus, *Channa Punctatus*. Journal of Environmental Biology, 18, 291.
- [24] Hilmy AH, Shabano MB and Daabes AY. (1985). Bioaccumulation of cadmium: Toxicity in Mugilcephalu. Comparative Biochemistry and Physiology, 81, 139-144.

---

### How to cite this article

Kamaraj C and Thamilmani K. (2018). Impact of polycyclic aromatic hydrocarbon effluent on the enzyme activity in blood serum of freshwater food fish *Cirrhinus mrigala*. GSC Biological and Pharmaceutical Sciences, 4(3), 24-28.

---