E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2018; 6(5): 198-205

www.fisheriesjournal.com
Received: 27-07-2018
Accepted: 28-08-2018

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Impact of sewage water on the changes in behaviour and bodyweight of a freshwater fish, *Cyprinus carpio* (Linnaeus)

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Abstract
The aquatic environment is subjected to heavy and diverse pollutants load, particularly in the highly industrialized and urbanized regions. There is much concern over possible effects of these pollutants on aquatic life. This sewage water was procured from the local area, nearby Ammanikere pond, Tumakuru, Karnataka, India. Short term definitive test by static renewal bioassay method was conducted to determine the acute toxicity (LC_{50}) of sewage water and freshwater fish fingerlings were exposed to different concentrations of sewage water 15ml/L for 96hrs, 30ml/L for 96hrs, 60ml/L for 96hrs and 120ml/L for 96hrs were selected for acute study on fish, *Cyprinus carpio* procured from Fisheries Research and Information Centre (Inland) Hebbal, Bangalore, Karnataka, India. The size of the fish will be (3 ± 0.21 g; 3 ± 0.25 cm) and duration of the study will be 1, 5, 10 & 15 days respectively. The present study shows that behaviour condition of the fishes were varies and symptoms dictated like irregular, erratic and darting swimming movements, hyper excitability, capsizing, attaching to the surface, restlessness, difficulty in breathing, loss of equilibrium and gathering around the ventilation filter and the bodyweight of the fishes also decreases slowly up to 15 days of time period. This present investigation shows that impact of sewage water on the changes in behaviour and bodyweight of a freshwater fish, *Cyprinus carpio*. For this study the treatment of toxic effects of sewage water on the desired fish species that is *Cyprinus carpio* was found suitable for the exposure based on the available literature survey. The results of the study evidenced that sewage is toxic and thus, it has led to the altered fish physiology. However the exact mechanism through which this is achieved needs to be studied further.

Keywords: Sewage Water, Ammanikere pond, behaviour, bodyweight & *Cyprinus carpio*

Introduction
Today's scenario in this globe water is the most significant component for the existence of life on the earth. It is distributed in environment in different forms such as river water, rain water, mineral water and spring water etc., In this world today human population suffering lots of water problems day by day and some of the disputes from mankind on this type of habitat due to scarcity of water because dense population, utilization of river, lakes, ponds, streams etc., for different type of industrial as well as agricultural purpose, pollution is a serious issue in recent times, the natural resources of water bodies such as rivers, ponds, lakes and seas are polluted with a variety of solid and liquid wastes causing a great damage to the aquatic ecosystems (Gupta B.K *et al.,* 2012) [12]. The two most important processes that effect the global environment are the resource production and the waste disposal. A proper balance between these two is necessary for a healthy biosphere.

Although, certain resources are often created for some useful purpose, on actual use some such resources contaminate and pollute the environment. Besides, every human society, be it rural or urban, industrially or technologically advanced, disposes maximum amount of sewage water to natural ecosystem and certain bi-products and waste products into the environment, which he evidenced that there is a problem with sewage as well as industrial effluent to ecosystems (Patro L, 2006) [27], (Patoine A, 2002) [26]

Globally on this planet today there is a Hasty urbanization and industrialization releases enormous volumes of waste water which is utilized by mankind in various purposes, which is increasingly utilized as a valuable resource for irrigation in urban and peri-urban agriculture. It drives significant economic activity, supports countless livelihoods particularly those of

farmers, and substantially changes the water quality of natural water bodies. Due to industrialization and urbanization, it is becoming more polluted and risk of this polluted water consumption and its sanitation problem is increasing day to day in most of the developing countries. (Gurinder K.W *et al.,* 2015) [14]

This growing problem of water scarcity has significant negative influence on economic development, human livelihoods and environmental quality throughout the world. (Marshall F.M *et al.,* 2007) [20], (Lopes, 2001) [19] contaminated irrigation water and food safety for the urban and peri-urban poor: appropriate measures for monitoring and control from field research in India and Zambia, Inception Report DFID Enkar R8160, SPRU, University of Sussex. One of the most critical environmental problems of the century was pollution of rivers and streams with chemical contaminants. Some of these chemicals are biodegradable and quickly decay into harmless or less harmful forms, while others are non-biodegradable and remain dangerous for a long time this was reported in Behavioral and Respiratory Responses of the Freshwater Fish, *Cyprinus carpio* (*Linnaeus*) exposed to Cadmium chloride by (Shivaraj and Asiya Nuzhat F.B 2015) [32]

Hence, it has become an essential need for today`s environment to protect water from getting polluted or to develop cost effective remedial method for its protection. It is estimated that approximately 1.1 billion people globally drink unsafe water. The major microbial populations found in waste water treatment systems are bacteria, protozoa, viruses, fungi, algae and helminthes. The presence of most of these organisms in water which leads to spread of ailments it is through epidemic, the two major chemical pollutants in wastewater are nitrogen and phosphorus. Although there are other chemical pollutants, such as heavy metals, detergents and pesticides, nitrogen and phosphorous are the most frequent limiting nutrients in eutrophication (Varma. S.R *et al.,* 1978) [35]

There is wide lacuna in this field of sewage water toxicity on freshwater fishes prompted to take up this investigation further (Gupta B.K *et al.,* 2012) [13]. In this work the survey of literature reflects that, the sewage water affects a wide range of non-target organisms such as fishes and other aquatic organisms (Das P.C *et al.,* 2004) [5]. No information was available on the direct effect of the sewage water of the household and industries on freshwater fishes (Tilak, 2007) [33]. The sewage water of the industry leaches and enters neighbouring ponds (Benejam L, 2008) [3] and contaminated the ponds, where this *Cyprinus carpio* (Linnaeus) was mass cultured. Hence, this project was designed for instant information on the issue (Venkateshwarlu N.D *et al.,* 2016) [34]. In outlook of the foregoing account the present investigation was projected to understand the impact of lethal concentration of sewage water on the freshwater fish, Common carp, *Cyprinus carpio* (Linnaeus).

Materials and Methods

Collection of Carp, and Their Maintenance

The collection of carp, from Fisheries Research and Information Center (Inland) Hebbal, Bangalore, Karnataka, India, provided healthy and active 1-month old Common *Carp, Cyprinus carpio* fingerlings (3 ± 0.21 g; 3 ± 0.25 cm). Large aerated crates were used to transport fish to the laboratory. Before investigation fish were maintained for 30 days in large cement tanks (22 × 12 × 5 feet). Further, carp (50 fingerlings) were conditioned (acclimatized) to laboratory conditions for 20 days at 22 ± 2 ºC in 100 L glass aquaria (120 × 45 × 80 cm) containing dechlorinated tap water of the quality used in the test. Characteristics of the water were determined by following the methods mentioned in (APHA, 2005) [2] and are presented in Table 1.

Table 1: Physico-chemical characteristics of water quality used in the present studies.

Variable	:	Datum
Temperature	:	22 ± 2 ºC
pH	:	7. 09 ± 0.10 at 24 ºC
Dissolved oxygen	:	8. 90 ± 0.45 mg/L
Carbon dioxide	:	2. 30 ± 0.25 mg/L
Total hardness	:	27.3 ± 3.3 mg as $CaCO_3$/L
Total alkalinity	:	21.4 ± 5.1 mg as $CaCO_3$/L
Conductivity	:	< 10 µS/cm
Chlorinity/Chloride	:	46.3 mg/l

Experimental Toxicant

Sewage water (domestic waste water or municipal waste water) is a type of waste water that is produced from a community of people. It is characterized by volume or rate of flow, physical condition, chemical and toxic constituents, and its bacteriologic status. It consists mostly of grey water (from sinks, tubs, showers, dishwashers, and clothes washers), black water (the water used to flush toilets, combined with the human waste that it flushes away); soaps and detergents; and toilet paper (less so in regions where bidets are used). The term sewage is nowadays regarded as an older term and is being more and more replaced by "wastewater". So we choose as a (toxic substance) based on the some of the literature survey. This sewage water was procured from the local area, nearby Ammanikere pond, Tumakuru, Karnataka, India. For this study the treatment of toxic effects of sewage water on the desired fish species that is *Cyprinus carpio* was found suitable for the exposure based on the available literature survey.

Acute Toxicity Test

The acute toxicity (96h LC_{50}) of Sewage water for the freshwater fish, Common carp, *Cyprinus carpio* was determined in the laboratory using the semi-static method in (OECD, 1992) [24]. The carp (10 fingerlings in 20L of test medium in each replicate) were exposed to varying concentrations of Sewage water with two replicates for each concentration along with the control sets. Test medium was renewed for every 24h with their respective test concentrations of the toxicant without aeration.

Experimental Design and Test Concentrations

In this experiment lethal concentration of Sewage water 15ml/L for 96hrs, 30ml/L for 96hrs, 60ml/L for 96hrs and 120ml/L for 96hrs were selected for acute study. Each replicates possessed 10 fish in 20 L of the test medium and two replicates group -1 (control) and group-2 (treated) were maintained for each concentration and control. Common carp, *Cyprinus carpio* were exposed to both the test concentrations for 15 days of time but 96hrs for each group were exposed the concentration levels of each groups were 15, 30, 60 & 120ml/L increased up to the mortality arises in this level of exposure and could recover in toxicant free medium for seven days. In this experimental period test medium was renewed daily followed by addition of respective test concentrations of

Sewage water only up to day 15 without aeration, respectively.

Results

First Exposure: 1, 2, 3 & 4 Day Exposure-Control Groups

Table 2: It indicates that Bodyweight and Behavioural Toxicological Symptoms appear to be normal in day-1, 2, 3 & 4 Control group of fish, *Cyprinus carpio*.

Dose Concentrations/ Days/hrs	Number of fishes	Bodyweight in gms Day-1	Body weight in gms Day-2	Body weight in gms Day-3	Body weight in gms Day-4	Behavioural Toxicological Symptoms Day-1 to Day-4
0ml/L/ Day-1, 2, 3 & 4/ 24, 48, 72 & 96 hrs	01	0.9	0.9	0.9	0.9	N
	02	1.3	1.3	1.3	1.3	N
	03	1.0	1.0	1.0	1.0	N
	04	1.5	1.5	1.5	1.5	N
	05	1.0	1.0	1.0	1.0	N
	06	1.2	1.2	1.2	1.2	N
	07	0.8	0.8	0.8	0.8	N
	08	1.8	1.8	1.8	1.8	N
	09	1.1	1.1	1.1	1.1	N
	10	1.4	1.4	1.4	1.4	N

There is no significance in the present table and N-Normal

First Exposure: 1, 2, 3 & 4 Day Exposure-Treared Groups

Table 3: It indicates that Bodyweight and Behavioural Toxicological Symptoms appear

Dose Concentrations/ Days/hrs	Number of fishes	Bodyweight in gms Day-1	Body weight in gms Day-2	Body weight in gms Day-3	Body weight in gms Day-4	Behavioural Toxicological Symptoms Day-1 to Day-4
15ml/L/ Day-1, 2, 3 & 4/ 24, 48, 72 & 96 hrs	01	1.2	1.0	1.0	1.0	N
	02	1.3	1.3	1.3	1.2	N
	03	2.0	1.8	1.7	1.7	N
	04	1.5	1.5	1.5	1.5	N
	05	1.4	1.4	1.4	1.4	N
	06	1.7	1.4	1.4	1.5	N
	07	2.0	1.9	1.7	1.7	N
	08	1.9	1.6	1.6	1.6	N
	09	2.1	1.8	1.6	1.7	N
	10	2.3	2.0	1.9	1.1	N

to be normal in day-1, 2, 3 & 4 Treated group of fish, *Cyprinus carpio*.
There is no significance in the present table and N-Normal

Second Exposure: 1, 2, 3 & 4 day Exposure-Control Groups

Table 4: It indicates that Bodyweight and Behavioural Toxicological Symptoms appear to be normal in day-1, 2, 3 & 4 Control group of fish, *Cyprinus carpio*.

Dose Concentrations/ Days/hrs	Number of fishes	Bodyweight in gms Day-1	Body weight in gms Day-2	Body weight in gms Day-3	Body weight in gms Day-4	Behavioural Toxicological Symptoms Day-1 to Day-4
0ml/L/ Day-1, 2, 3 & 4/ 24, 48, 72 & 96 hrs	01	1.5	1.4	1.4	1.4	N
	02	1.6	1.6	1.6	1.6	N
	03	2.2	2.3	2.3	2.3	N
	04	2.0	2.0	2.0	2.0	N
	05	2.8	2.8	2.8	2.8	N
	06	1.7	1.7	1.7	1.5	N
	07	2.6	2.6	2.2	2.2	N
	08	2.5	2.5	2.5	2.5	N
	09	2.3	2.3	2.3	2.3	N
	10	2.9	2.9	2.9	2.9	N

There is no significance in the present table and N-Normal

Second Exposure: 1, 2, 3 & 4 Day Exposure-Treated Groups

Table 5: It indicates that Bodyweight and Behavioural Toxicological Symptoms appear to be normal in day-1, 2, 3 & 4 Treated group of fish, *Cyprinus carpio*.

Dose Concentrations/ Days/hrs	Number of fishes	Bodyweight in gms Day-1	Body weight in gms Day-2	Body weight in gms Day-3	Body weight in gms Day-4	Behavioural Toxicological Symptoms Day-1 to Day-4
30ml/L/ Day-1, 2, 3 & 4/ 24, 48, 72 & 96 hrs	01	1.5	1.6	1.3	1.3	N
	02	1.6	1.4	1.4	1.5	N
	03	2.3	2.3	2.3	2.3	N
	04	2.0	2.0	2.0	2.0	N
	05	2.8	2.8	2.3	2.3	N
	06	1.7	1.7	1.7	1.7	N
	07	2.8	2.6	2.2	2.2	N
	08	2.5	2.5	2.5	2.5	N
	09	2.4	2.4	2.1	2.7	N
	10	2.9	2.5	2.3	2.3	N

There is no significance in the present table and N-Normal

Third Exposure: 1, 2, 3 & 4 Day Exposure-Control Groups

Table 6: It indicates that Bodyweight and Behavioural Toxicological Symptoms appear to be normal in day-1, 2, 3 & 4 Control group of fish, *Cyprinus carpio*.

Dose Concentrations/ Days/hrs	Number of fishes	Bodyweight in gms Day-1	Body weight in gms Day-2	Body weight in gms Day-3	Body weight in gms Day-4	Behavioural Toxicological Symptoms Day-1 to Day-4
0ml/L/ Day-1, 2, 3 & 4/ 24, 48, 72 & 96 hrs	01	2.5	2.4	2.4	2.4	N
	02	3.0	3.1	3.1	3.1	N
	03	2.7	2.7	2.6	2.6	N
	04	2.9	2.9	2.9	2.9	N
	05	2.6	2.6	2.6	2.8	N
	06	2.5	2.5	2.5	2.5	N
	07	3.4	3.4	3.4	3.4	N
	08	2.8	2.6	2.6	2.6	N
	09	3.3	3.3	3.3	3.1	N
	10	3.5	3.5	3.4	3.4	N

There is no significance in the present table and N-Normal

Third Exposure: 1, 2, 3 & 4 Day Exposure-Treated Groups

Table 7: It indicates that Bodyweight and Behavioural Toxicological Symptoms appear to be normal in day-1, 2, 3 & 4 Treated group of fish, *Cyprinus carpio*.

Dose Concentrations/ Days/hrs	Number of fishes	Bodyweight in gms Day-1	Body weight in gms Day-2	Body weight in gms Day-3	Body weight in gms Day-4	Behavioural Toxicological Symptoms Day-1 to Day-4
60ml/L/ Day-1, 2, 3 & 4/ 24, 48, 72 & 96 hrs	01	2.6	2.6	2.6	2.6	Irregular, Erratic and darting swimming movements, Hyper excitability, Capsizing, Attaching to the surface, Restlessness, Difficulty in breathing, Loss of equilibrium and Gathering around the ventilation filter
	02	3.0	2.9	2.9	2.9	
	03	2.7	2.7	2.5	2.5	
	04	2.9	2.6	2.6	2.6	
	05	2.6	2.2	2.2	2.2	
	06	2.5	2.5	2.5	2.5	
	07	3.4	3.0	2.6	2.6	
	08	2.8	2.8	2.7	2.9	
	09	3.1	3.0	3.0	3.0	
	10	3.4	3.1	2.8	2.7	

There is significance in the present table and some of the Behavioural symptoms occur

Fourth Exposure: 1, 2, 3 & 4 Day Exposure-Control Groups

Table 8: It indicates that Bodyweight and Behavioural Toxicological Symptoms appear to be normal in day-1, 2, 3 & 4 Control group of fish, *Cyprinus carpio*.

Dose Concentrations/ Days/hrs	Number of fishes	Bodyweight in gms Day-1	Body weight in gms Day-2	Body weight in gms Day-3	Body weight in gms Day-4	Behavioural Toxicological Symptoms Day-1 to Day-4
0ml/L/ Day-1, 2, 3 & 4/ 24, 48, 72 & 96 hrs	01	3.6	3.6	3.6	3.6	N
	02	4.0	4.0	4.0	4.0	N
	03	3.9	3.9	3.7	3.5	N
	04	3.2	3.2	3.2	3.2	N
	05	4.0	4.0	4.0	4.0	N
	06	3.4	3.4	3.4	3.2	N
	07	4.2	4.2	4.1	4.1	N
	08	3.5	3.5	3.5	3.5	N
	09	4.1	4.1	4.1	4.1	N
	10	4.5	4.5	4.4	4.0	N

There is no significance in the present table and N-Normal

Fourth Exposure: 1, 2, 3 & 4 Day Exposure-Treated Groups

Table 9: It indicates that Bodyweight and Behavioural Toxicological Symptoms appear to be normal in day-1, 2, 3 & 4 Treated group of fish, *Cyprinus carpio*.

Dose Concentrations/ Days/hrs	Number of fishes	Bodyweight in gms Day-1	Body weight in gms Day-2	Body weight in gms Day-3	Body weight in gms Day-4	Behavioural Toxicological Symptoms Day-1 to Day-4
120ml/L/ Day-1, 2, 3 & 4/ 24, 48, 72 & 96 hrs	01	3.9	3.9	4.0	3.3	Irregular, Erratic and darting swimming movements, Hyper excitability, Capsizing, Attaching to the surface, Restlessness, Difficulty in breathing, Loss of equilibrium and Gathering around the ventilation filter
	02	3.8	3.1	3.1	3.1	
	03	3.7	3.2	2.9	2.9	
	04	3.2	3.2	3.0	3.0	
	05	4.0	3.5	2.8	2.8	
	06	3.2	3.2	3.2	3.1	
	07	4.2	3.6	2.7	2.7	
	08	3.5	3.5	3.5	2.8	
	09	4.0	3.2	2.8	2.8	
	10	4.9	3.9	3.4	3.4	

There is significance in the present table and some of the Behavioural symptoms occur

First Exposure: Periods
Day-1 to Day-4 Control Groups
Normal fish:

In this present investigation control fishes maintained a fairly compact school, covering about one third of the bottom during the first five days of the 15 days experiment time period. By fifth day, the school became less compact covering up to two-third of the tank area in stock. Fishes were observed to scrap the bottom surface inside the aquarium. When these fishes were frightened, they instantly formed a school that was maintained briefly and this aquatic species they were highly sensitive to light and moved to the bottom of the tank when light was passed into the tank/aquarium. Except a less response to form a dense school towards the end of the study, no other astonishing behaviour symptoms and morphological signs was observed in this test system.

In this present investigation fishes were exposed normal tap water media dose concentration will be 0ml/L, used as a control group there is no change in all the part of the exposure replicates groups like 1-control and 1-treated but we concentrated on both the groups up to the period of 96 hrs, it represents the following table - 2 which indicates the body weight and behavioural activity will be remains same, there is no morphological anomalies found and this shows that the fishes are in normal condition.

Day-1 to Day-4 Treated Groups

In this present study fishes were exposed sewage water and dose concentration will be 15ml/L, which I selected this concentration based on review of literature survey and in this study we used as a control group there is no change in all the part of the exposure replicates groups like 1-control and 1-treated but we concentrated on both the groups up to the period of 96 hrs, it represents the following table - 3 which indicates the body weight and behavioural activity will be remains same, there is no other changes found in this 96 hrs exposure period and finally this shows that the fishes are in normal condition.

Second Exposure: Periods
Day-1 to Day-4 Control Group

In this present investigation fishes were exposed normal tap water media dose concentration will be 0ml/L, used as a control group there is no change in all the part of the exposure replicates groups like 1-control and 1-treated but we concentrated on both the groups up to the period of 96 hrs, it represents the following table - 4 which indicates the body weight and behavioural activity will be remains same, there is no morphological anomalies found and this shows that the fishes are in normal condition.

Day-1 to Day-4 Treated Group

In this present study fishes were exposed sewage water and dose concentration will be 30ml/L, which I selected this concentration based on review of literature survey and in this study we used as a control group there is no change in all the part of the exposure replicates groups like 1-control and 1-treated but we concentrated on both the groups up to the period of 96 hrs, it represents the following table - 5 which indicates the body weight and behavioural activity will be remains same, there is no other changes found in this 96 hrs exposure period and finally this shows that the fishes are in normal condition.

Third Exposure: Periods

Day-1 to Day-4 Control Group

In this present investigation fishes were exposed normal tap water media dose concentration will be 0ml/L, used as a control group there is no change in all the part of the exposure replicates groups like 1-control and 1-treated but we concentrated on both the groups up to the period of 96 hrs, it represents the following table - 6 which indicates the body weight and behavioural activity will be remains same, there is no morphological anomalies found and this shows that the fishes are in normal condition.

Day-1 to Day-4 Treated Group

In this present study fishes were exposed sewage water and dose concentration will be 60ml/L, which I selected this concentration based on review of literature survey and in this study we used as a control group there is no change in all the part of the exposure replicates groups like 1-control and 1-treated but we concentrated on both the groups up to the period of 96 hrs, it represents the following table - 7 which indicates the body weight which slowly changes the behavioural activity will be found during exposure time period like irregular, erratic and darting swimming movements, hyper excitability, capsizing, attaching to the surface, restlessness, difficulty in breathing, loss of equilibrium and gathering around the ventilation filter, and finally no gross pathological lesions were found throughout the experimental period. Hence, this study shows that there are some of the behavioural symptoms found due to the stress and finally this sewage water is toxic to all the aquatic species.

Fourth Exposure: Periods

Day-1 to Day-4 Control Group

In this present investigation fishes were exposed normal tap water media dose concentration will be 0ml/L, used as a control group there is no change in all the part of the exposure replicates groups like 1-control and 1-treated but we concentrated on both the groups up to the period of 96 hrs, it represents the following table - 8 which indicates the body weight and behavioural activity will be remains same, there is no morphological anomalies found and this shows that the fishes are in normal condition.

Day-1 to Day-4 Treated Group

In this present study fishes were exposed sewage water and dose concentration will be 120ml/L, which I selected this concentration based on review of literature survey and in this study we used as a control group there is no change in all the part of the exposure replicates groups like 1-control and 1-treated but we concentrated on both the groups up to the period of 96 hrs, it represents the following table - 9 which indicates the body weight changes and slowly changes the behavioural activity will be found during exposure time period like irregular, erratic and darting swimming movements, hyper excitability, capsizing, attaching to the surface, restlessness, difficulty in breathing, loss of equilibrium and gathering around the ventilation filter Hence, this study shows that there is a some of the behavioural symptoms found due to the stress, and finally this sewage water is toxic to all the aquatic species.

Discussion

In this days the present work, the migration of the fish to the bottom of the tank following the addition of sewage water, clearly indicates the avoidance, behaviour of the fish as observed in trout which was reported by (Christensen, 1975) [4] have observed the avoidance nature by rainbow trout and Atlantic salmon on exposure to four pollutants viz., Alkyl benzene, Sulfonate (AVS), Phenolchlorine and Kraft pulp effluent reported by (David M *et al.*, 2009) [7], (David M and Chebbi S.B, 2010) [6] in various species of fish. It has been also reported by (Folmar, 1976) [10] that Rainbow trout can detect and avoid copper sulphate, dalapon 2, 4-D (DMA), xylene and acrolein (Alghanim K.A, 2011) [1]. When abate was applied to river Oti in Ghana to control similum larvae, fish found at that site were observed to show avoidance reaction (Henry and Atchinson, 1986) [16]

Disruption of schooling behaviour of the fish, due to the lethal and sub-lethal stress of the toxicant, results in increased swimming activity (Perkin J.S and Bonner T.H, 2016) [28] and entails increased expenditure of energy (Hasen, 1972) [15]. A change in the normal physiological and bio-chemical aspects in the treated fish in the present study could be attributed to the disruption of the schooling behaviour of the fish, which in turn leads to hyper activities as suggested by (Weis and Weis 1974) [37] have reported that cadmium has a marked effect on the schooling behaviour of the Atlantic silverside (Schaumburg, 1976) [29]. Loss of such behaviour following heavy metal exposures has been observed by (Drummond, 1986) [8] (Vinodhini R and Narayanan M, 2008) [36]. The erratic swimming of the treated fish indicates loss of equilibrium. It is likely that the region in the brain which is associated with the maintenance of equilibrium should have been affected (Drummond, 1978) [9]. Loss of equilibrium and erratic swimming are reported in blue gills exposed to dursban (Mehrle and Mayer, 1975) [21]. Excited and erratic movements were observed by (Henry and Atchinson, 1986) [16]. Increase in fin "flickers" observed in the treated fish is not uncommon (Drummond, 1986) [8]. These behavioural changes were seen in the present investigation also.

The hyperexcitability of the fish in the lethal and sub lethal exposure of Cadmium (Herger W *et al.*, 1995) [17] may probably be hindrance in the functioning of the enzyme AChE in relation to nervous system as suggested by the authors (Shakul H and Vadamalai, 1986) [31], (Mukharjee D *et al.*, 1994) [23]. It leads to accumulation of acetylcholine which is likely to cause prolonged excitatory post synaptic potential. This may first lead to stimulation and later cause a block in the cholinergic system (Scott D.M *et al.*, 2005) [30]. Heavy metal exposure manifest into hyperactivity of muscles in Blunt-nose minnow (Mount, 1962) [22] Gold fish (Grant and Mehrle, 1970) [12]. According to (David *et al.*, 2009) [7], (Leduce A.O *et al.*, 2013) [18] behavioural patterns are also influenced by bio-chemical changes at the tissue level.

According to (Shivaraj *et al.,* 2015) [32] fishes slowly became lethargic, hyper excited, restless and secreted excess mucus all over the body. Mucus secretion in fish forms a barrier between body and toxic media thereby probably reduces contact of toxicant so as to minimize its irritating effect, or to eliminate it through epidermal mucus. The significant alterations observed in the bio-chemical constituents of gill, liver and muscle in the present investigation corroborate with the above view that bio-chemical change at the tissue level of the dosed fish contribute to the abnormal behaviour of the fish (Freund J.G and Petty J.T 2007) [11], (Oliveira S.R.D, 2008) [25]

Conclusion

The Present toxic study concluded that, in this toxic exposure periods the results were evidenced that the sewage water is highly toxic to the aquatic species and devastatingly affected behavioural responses of Common carp, *Cyprinus carpio*. Sewage water depicted terrible impact on bodyweight and behaviour affects. The results were seen to be valuable tool that should be incorporated to a battery of biomarkers to maximize the confidence with which eco-toxicologists and environmental toxicologists assess impacts of toxic pollution in the aquatic environment.

Acknowledgements

I acknowledge with great respect, immense pleasure, and rare privilege of my gratitude to my guide and my beloved parents, for their assistance and guidance during my Project work.

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