ISSN 0976 – 3333

Available Online at www.ijpba.info

International Journal of Pharmaceutical & Biological Archives 2014; 5(2): 145 – 149

ORIGINAL RESEARCH ARTICLE

The Sub-Lethal Effect of Detergent on the Biochemical Parameter of Fresh Water Fish, *Catla catla*

K. V. Arivizhivendhan[1], Jawahar Ali [2], P. Chitrarasu[2], R. Sampath kumar[2], R. Boopathy[3], M. Mahesh[3]and R. Regina Mary[*1]

[1]PG & Research Department of Zoology, Auxilium College, Vellore -623 006, Tamilnadu, India
[2]Unit of Aquaculture and Aquatic Toxicology, The New College, Chennai - 600 014. Tamilnadu, India
[3]Central Leather Research Institute (CSIR,) Adyar, Chennai - 600 020, Tamilnadu, India

Received 26 Nov 2013; Revised 03 Apr 2014; Accepted 13 Apr 2014

ABSTRACT

The presence of detergent in the sewage water increases the toxicity, which affect all the flora and fauna of the aquatic ecosystem. In this present investigation, toxicity effect of detergent on biochemical constituents of protein, lipid, glucose and glycogen on various tissues (muscle, gills, liver, heart and kidney) of the fresh water edible fish, *Catla catla*. The fish was acclimatized in laboratory condition for the experiment and fed with oil cake twice a day. The acute toxic lethal concentration (LC_{50} 96 hrs) was carried out by probit graphic method at 14.20 ppm of detergent from this concentration 1/5 value was taken for sub-lethal concentration (2.84 ppm) for two weeks period of exposure (7^{th} and 14^{th} day). The result showed that the percentage depletion was observed in all the selected biochemical constituents expect glycogen seems to be increased than the control experiment. The direct consumption of those fish may certainly affect the consuming animals including humans by biomagnifications.

Key words: Detergent, *Catla catla*, Sub-lethal effect and Biochemical parameters.

1. INTRODUCTION

Detergents can have poisonous effects in all types of aquatic life. The reducing of air water interaction foremost to insufficiency of oxygen for the aquatic animal underneath the water surface water contamination by the detergent has been reason for the obliteration of flora and fauna [4]. All detergents destroy the external layers that protect the fish from bacteria and parasites, cause damage to the gills epithelium by changing the lipid composition of the tissues and affecting the production of mucus, decrease the breathing ability, affect the peripheral nerve receptors of fish which causes changes in feeding and thermoregulatory behavior. Problems that occurred due to detergent pollution in the aquatic ecosystems are mostly the water quality degradation due to the low diffusion rate of oxygen from the air in to the water, which resulted in the oxygen intake failure of the aquatic organisms. In short term, the accumulation of detergent in the water may disturb the vision (eyes) of the fish as well as create gill damage. Acute toxicity studies of Cadmium on the edible carp, *Catla catla* revealed significant changes in the biochemical constituents of the fish like glucose, glycogen, total proteins, lipids and free amino acids [19]. The effect of detergent on biochemical levels in brain and gill of *Mystusmon tetanus* was reported by Chandanshive and Kamble [3]. The toxicity effect of detergent on biochemical parameter of fresh water fishes.

Detergents may also affect the liver of aquatic organisms indirectly through absorption of certain tissue, as liver acts as detoxicant of any toxic substances enters the body [22]. It was mentioned further that the first liver damage found was congestion, i.e. the increase of the blood volume in the blood capillaries. The failure of oxygen intake by the fish and liver damage result in the growth retardation [6, 22]. The aims of this investigation were to resolve the median lethal concentration (96-h LC50) of detergent and to study the biochemical constituent alterations in the fish organs *viz*., muscle, gills, liver, heart and kidney of *Catla catla* in sub-lethal concentration of detergent exposure.

Corresponding Author: R. Regina Mary, **E. mail:** arivizhi@gmail.com

2. MATERIALS AND METHODS

2.1. Collection of fish (*Catla catla*) and detergent solution preparation

Healthy fingerlings of *C. catla* measuring about 3.3 – 4.5 cm in length, weighing about 5.5 -7 gms were procured from Poondi, Thiruvalluar district, Tamil Nadu, India. The experimental fish were transported to the Unit of Aquaculture and Aquatic Toxicology, New college laboratory by plastic bags. The different concentration of detergent was prepared from the commercial available surf excel detergent powder in a demonized water.

2.2 Experimental set up for acute and chronic toxicity study

The experiment was carried out in a ten separate tank (15 L) each containing 10 numbers of fishes in a ventilated closed room and one tank was kept as a control. The 75 % volume of de-chlorinated tap water was taken and acclimatized for 15 days. The aeration was provided diffusing compressed air (2.1 kgf/cm^2) through air sparger. During the experiment and acclimatizing period, de-oiled cake (1 g) was fed thrice a day by dissolving in 10 mL of de-ionized water. The tap water was adjusted to 7.5±0.3 using 1N of HCl and NaOH solution.

The experiment was carried out by varying the concentrations of detergent (10, 12, 14, 16 and 18 ppm)to study the acute toxicity. Six tanks with the fishes after adaptation period were taken, five different concentration of detergent (10, 12, 14, 16 & 18) was added in the first five tanks and six was considered as control. The acute toxicity was checked for each 24 hr of exposure time, fingerlings were not feed during the experimental study. The LC_{50} value was found to be 14.2 ppm concentration of detergent by probit analysis.

Further, the fish were exposed to chronic toxicity study. One fourth of the lethal concentration (1/4th of 96 hours LC_{50} = 3.55ppm) was taken as sub lethal dose for anobservation period of 2 weeks. The chronic toxicity experiment was run to investigate the impact of sub-lethal concentration on the biochemical parameters (glucose, glycogen, protein and lipid) on various tissues of muscle, gills, liver, heart and kidney of the treated *C. catla* fingerlings on each 24 hrs of exposure before the tap water was changed from the tank. Control and treated test animals tissues (Muscle, Gill, Liver, Heart and Kidney) were dissected out after 7th, 14th and 30th day of exposure. The carbohydrates, proteins, lipids, and glycogen were estimated by following the methodology described elsewhere (7, 10 & 13) respectively.

3. RESULTS

Acute toxicity study of *Catla Catla*on detergent exposure

Acute toxicity effect of detergent exposure to *Catla catla* fish was studied by varying the detergent concentration from 10ppm, 12ppm, 14ppm, 16ppm and 18ppm respectively. The Fig1: show the increase in mortality percentage was significantly increased with increase in concentration of detergent and exposure. The maximum mortality percentage was observed to be 18 ppm concentration of detergent (96.7 %) for an exposure period of 96 hr. The least mortality was observed at 10 ppm concentration (6.7 %). The LC_{50} value of the detergent to *C. catla* was found to be 14.20 ppm for an exposure period of 96 hr. The same kind of toxicity effect was observed by [2, 11, 14].

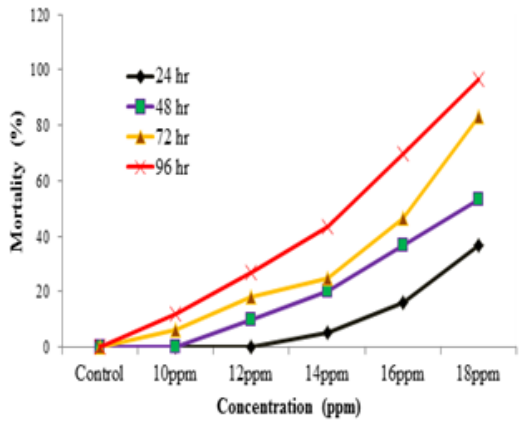

Fig 1: (a) Mortality (%) of *C. catla* on exposed to different concentrations of detergent (After 24, 48, 72 and 96 hours)

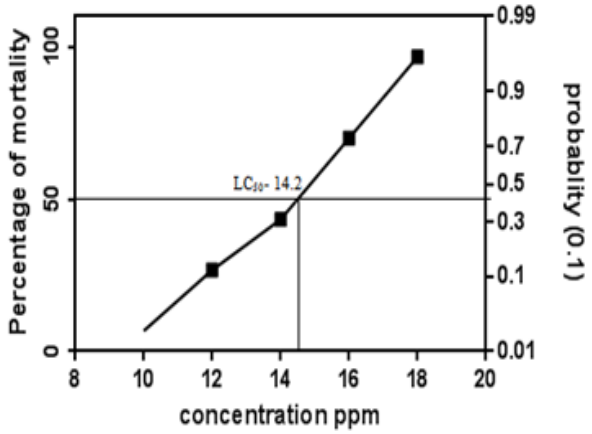

Fig 2: (b) LC50 curve

This relates to various factors like difference in species of fish, period of exposure stage of life cycle and also experimental condition in

© 2010, IJPBA. All Rights Reserved.

prevailing. When the fish was exposed to lethal concentration, body surface acquired dark color before their death which is one of the symptoms of toxicity. The mucus was observed all over the body and also on the gill in excess secretion of mucus in fish forms a nonspecific response against toxicant [16]. When fish exposed to detergent various behavioral changes were observed which include swimming the surface of water. Behavioral alteration have been establishes as sensitive indicator of chemically induces stress in aquatic organism.

Chronic study on detergent exposure

The fishes after acute toxicity study of 14.2 ppm concentration of detergent (LC_{50} level) for an exposure period of 96 h where taken into chronic study (**Fig 1**).

The one fourth of LC_{50} value was chosen as a sub-lethal concentration (2.9 ppm) in the chronic experiment for a study period of30 days. In these experiment influence of various biochemical parameters (glucose, glycogen, protein and lipid) on detergent exposure of various tissues (muscle, gills, liver, heart and kidney) of *C. catla* fish were studied. When fish exposed to sub-lethal and lethal concentration of detergent various behavioral changes were observed which include swimming the surface of water. Behavioral alteration have been establishes as sensitive indicator of chemically induces stress in aquatic organism [1, 12, 18]. When exposed to lethal concentration, body surface acquired dark color before their death which is one of the symptoms of toxicity. The mucus was observed all over the body and also on the gill in excess secretion of mucus in fish forms a nonspecific response against toxicant [16].

Table 1: Glucose level in various organs exposed to sub lethal concentration in detergent on *C. catla* fingerlings

ORGANS	CONTROL	7th DAY	% of increase	14th DAY	% of depletion	30th DAY	% of depletion
Muscle	8.74 ± 0.57	8.93±0.04	2.12%	7.01 ± 0.26*	19.79%	3.32 ± 0.45*	62.01%
Gill	2.96 ± 0.74	3.17±0.7	7.09%	1.40 ± 0.26	52.70%	0.92 ± 0.24*	68.91%
Liver	6.52 ± 0.68	6.85±0.15	5.06%	5.01± 0.52*	23.15%	2.24 ± 1.52*	65.64%
Heart	2.08 ± 0.57	2.26±0.25	8.65%	1.45 ± 0.35*	30.28%	0.87 ± 0.01*	58.17%
Kidney	3.76 ± 0.53	4.01±0.05	6.64%	3.05 ± 0.4*	18.88%	0.62 ± 0.17*	67.55%

Table 2: Protein level in various organs exposed to sub lethal concentration in detergent on *C. catla* fingerlings

ORGANS	CONTROL	7th DAY	% of increase	14th DAY	% of depletion	30th DAY	% of depletion
Muscle	8.74 ± 0.57	8.93±0.05	2.12%	7.01 ± 0.26*	19.79%	3.32 ± 0.45*	62.01%
Gill	2.96 ± 0.74	3.17±0.57	7.09%	1.40 ± 0.26	52.70%	0.92 ± 0.24*	68.91%
Liver	6.52 ± 0.68	6.85±0.05	5.06%	5.01± 0.52*	23.15%	2.24 ± 1.52*	65.64%
Heart	2.08 ± 0.57	2.26±0.07	8.65%	1.45 ± 0.35*	30.28%	0.87 ± 0.01*	58.17%
Kidney	3.76 ± 0.53	4.01±0.01	6.64%	3.05 ± 0.4*	18.88%	0.62 ± 0.17*	67.55%

Table 3: Glycogen level in various organs exposed to sub lethal concentration in detergent on *C. catla* fingerlings

ORGANS	CONTROL	7th DAY	% of increase	15th DAY	% of depletion	30th DAY	% of depletion
Muscle	24.95 ± 0.99	21.63±0.86	13.32%	20.06±0.25*	19.59%	15.34±0.36*	58.60%
Gill	8.72 ± 0.48	7.02±0.52*	19.49%	6.12 ± 0.54*	29.81%	3.93 ± 1.41*	54.93%
Liver	30.09 ± 0.93	23.39±0.01*	22.26%	20.37 ± 0.1*	32.30%	15.4 ± 0.02*	48.82%
Heart	14.23 ± 0.32	12.96±0.05*	8.92%	11.48 ± .64*	19.32%	7.89 ± 0.86*	44.55%
Kidney	20.79 ± 0.56	13.58±0.05*	34.68%	11.5 ± 0.74*	44.68%	8.38 ± 0.66*	59.69%

Table: 4 Glycogen level in various organs exposed to sub lethal concentration in detergent on *C. catla* fingerlings

ORGANS	CONTROL	7th DAY	% of increase	15th DAY	% of depletion	30th DAY	% of depletion
Muscle	85.48±1.05	65.63±0.57	23.22%	61.57±1.52*	27.97%	49.13±0.63*	42.52%
Gill	68.8 ± 0.92	49.58±0.05*	27.93%	46.18±0.02*	32.87%	34.28±0.01*	50.17%
Liver	84.2 ± 0.58	59.74±0.01*	29.04%	50.36±0.04*	40.19%	32.72±0.27*	61.14%
Heart	49.6 ± 0.57	38.85±0.43	21.67%	35.33±0.04*	28.77%	33.35±0.09*	32.76%
Kidney	52 ± 1.73	41.59±0.05*	20.01%	36.08±0.51*	30.61%	34.12±0.57*	34.38%

The glucose level is increasing in 7th day when compare to control in all tissues in the order of Heart>Gill>Kidney>Liver>Muscle are 2.12%, 5.06%, 6.64%, 7.09% and 8.65%. In 14th day glucose levels are decrease in the order of Gill>Heart>Liver>Muscle>Kidney is 52.70%, 30.28%, 23.15%, 19.79% and 18.88%. Glucose level also decrease in the order of Gill>Kidney >Liver>Muscle>Heart is 68.91%, 67.55%, 65.64%, 62.01% and 58.17% are show in (**Table 1**). The glucose level is increase in 7th day. This may be due to the conversion of glycogen to glucose and lipid into glucose by the pathway of Gluconeogenesis was reported by [15]. In long period 15th and 30th day, the glucose level was decreased the converted glucose is highly utilized by under the stress condition.

The protein level was decrease in 7th, 15thand 30thday while compare to control shows in (**Table 2**). The maximum depletion was occurring in muscle 59.69% and the minimum level of

© 2010, IJPBA. All Rights Reserved.

depletion was occurring in Heart (44.68%) in 30th day. The depletion of total protein content may be due to breakdown of protein into free amino acids under the effect of toxicant at the lower exposure period [17]. It indicates that detergent induces proteolysis in the fish even under sub lethal toxic stress [21] resulting in elevated levels of protein content but the degree of proteolysis appears day-dependent.

The maximum level of glycogen level was decreased in 7th day when compare to control in all tissues in the order of Kidney< Gill < Heart < Liver < Muscle are 50.39%, 49.27%, 47.95%, 47.79% and 46.06% respectively. In 15th day glycogen levels are decrease in the order of Kidney < Liver< Heart < Muscle < Gill is 79.88%, 76.28%, 72.51%, 62.52% and 59.17%. Glycogen level also decrease in the order of Kidney < Liver< Heart < Muscle < Gill are 88.67%, 88.38%, 85.67%, 80.08% and 76.9% shows in (**Table 3**). The glucose level is increase in 7th day. Glycogen level were decrease in both 7th, 14th and when compare to control, it indicate that the fish is detergent stress the process of glycolysis, as a result the glycogen converted into glucose [20]. So, the glucose level is increase in all tissues in 7th day.

The lipid levels also decreased in the tissues of the fish exposed to the sub-lethal concentration of toxicant. The maximum level of depletion was observed in liver (61.14%) exposure period of 30th day and minimum depletion was occurred in Heart (32.76%) shows in (**Table 4**). Because, the detergent affects the rate of Gluconeogenesis, as a result the lipid level was decreased. The depletion of lipid content may be due to increased utilization of lipid to meet additional energy requirements under a stress of low oxygen taken up [8]. Effect of detergent on the lipid content was reported by earlier investigators [5, 9].

CONCLUSION

Acute toxicity studies of Detergent on the edible carp, *Catla catla* revealed significant changes in the biochemical constituents of the fish like glucose, glycogen, total proteins and lipids. Haemorrhagic conditions observed in the dead fish clearly indicate the toxic effect of Detergent. The fish which were previously exposed to lower concentrations of Detergent have better resistance to higher concentrations of these Detergents. This might be due to the adaptive response which is characteristic of vertebrates. Thus the present study clearly indicates that detergent was found to be toxic to fish. It alters the biochemical constituents of fish. As a result survival of the fish would not be possible.

REFFERENCE

1. Agarwal S.K. (1991):bioarsay evaluation of acute toxicity levels of mercuric chloride ot an air breath fish *Channa punctatus* (Bloch). Mortality and behavior study. Environment bio 1., 12(2), 90-106.
2. Bhaskaran. P, Gopalakrishnaswamy. G and Sathyabama, 1991. Impact of commercial detergent (Nirma) on feeding energetic and protein metabolism in the teleost *Orechromis mossambicus*: J. Ecotoxical. Environ. Monit. 1 (1): 31-40.
3. Chandanshive N. E and Kamble S. M. (2008); Studies on the effect of certain detergent on glycogen content in brain and gill of freshwater fish *Mystus montatanus*. Aqua. Bio. Vol. 23(2) 2008; 139-143.
4. Ernst Haeckel, 1869. Definition of ecology: S.Chand publication New Delhi.
5. Dubale. M. S and Punita shah, 1981. Biochemical alterations induced by cadmium in the liver on *Channa punctatus*: Environmental research. 26 (1):110-118.
6. Himawan. S, 1998. Pathology University Indonesia: Jakarta3 448 hlm. Pathology: Indonesia University 448 pages).
7. Kemp A, Adrienne JM, Kits Van Hejningen, 1954. A colorimetric method for the determination of glycogen in tissues: The Biochemical Journal (56): 640-648.
8. Kulkarni, G.P.P., M.S. Dharwadkar, 1998. Effect of dairy effluent on biochemical parameters of wheat seeds and fish: Proc. Acad. Environ. Biol., 7, 57–60.
9. Levesque HM, Moon TW, Campbell PGC and Hontela A, 2002. Seasonal variation in carbohydrate and lipid metabolism of yellow perch *Perca flavescens* chronically exposed to metals in the field. Aquatic Toxicology: 60(3-4): 257-267.
10. Lowry OH, Rosenbrough NJ, Farr RL, Randall RJ, 1951. Protein measurement with the Folin Phenol reagent: J. Biol. Chem., (193): 265-275.
11. Maruthanayagam C, Arun. S and P. Suramaniyan, 1994. Acute toxicity of synthetic detergent to *Macrobra chiumlamerrei*: Adv. In . Zool. Series 1: 165-170.

© 2010, IJPBA. All Rights Reserved.

12. Olla B.L pearson and studholme A.L. (1980). Applicantly of behavioral measures in environmental stress assessment. Rapp P-V-Ronn Cons. Int. Explor Mer., 179,162-179.
13. Pande SV, Parvin Khan A, Venkatasubramanium. T. A, 1963. Microdetermination of lipids and serum fatty acids: Analyt. Biochem. 6 (5): 120-125.
14. Paul, P.I., Vincent. S, Ambrose. T and Selvanayagam. M, 1995. Activity of acid phosphates in selected tissues of *Sorothero donmossambicus* exposed to synthetic detergents. J. Eco. Bio 7 (1): 67-70.
15. Radhakrishnaiah, K., Venkatramana, P., Suresh, A. and Sivaramakrishna, B. 2005. Effect of lethal and sub-lethal concentration of copper on the glycolysis in liver and muscle of freshwater teleost Labeorohita (Ham). J. Environ. Biol. 139 (1): 63-68.
16. Rao J.V (2006) Toxic effect of Novel organs phosphorus insecticide (RPR-V) on certain biochemical parameters of eurylaline fish. *Oreochromis mossambicus* pesticide Biochemistry and Physiology 86-78-84.
17. Shakoori, A. R., JavedIqbal, M., Latif Mughal, A., Syed Shahid A, 1994. Bio chemical changes induced by inorganic mercury on the blood, liver and muscles of *Ctenopharyngo donidella*. J. Ecotoxicol. Environ. Monit. 4: 81–92.
18. Sharma U.D and Shukla S. (1990):Behavioural disfunction of fresh water prawn, *Macrobrachium lamarrci* (Curstacea:Decapoda) following exposure to synthetic detergent, linear alkyl benzene sulphate. Biolmem., 16(12) 58-61.
19. Sobha K (2007). A study on biochemical changes in the fresh water Fish, *Catla catla* (hamilton) exposed to the heavy Metal toxicant cadmium chloride Kathmandu University Journal of Science, Engineering and Technology, 1(4), august, 2007.
20. Vasanthi J, R. Kalavathi and N. Saradhamania (2012). Study on the effect of detergent surya gold on the biochemical constituents of the freshwater fish *Cirrhinus mrigala*. Asian Jr. of Microbiol. Biotech. Env. Sci., 14(1): 23-26.
21. Yellamma, K.; Ayyanna, K. and Reddy, T.V. 1995. Modulation in protein metabolism of *Oziotelphus senen* during cypemethrin intoxication. *Chem. Ecol*. 11 : 113-116.
22. Yatim. W, 1990. Biology and Modern Histology: Penerbit Transito publication Bandung, 374 pages.

© 2010, IJPBA. All Rights Reserved.