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IMPACT OF LAUNDARY DETERGENT ON ANTIOXIDATIVE SYSTEM OF CYPRINUS CARPIO.

Fish Toxicology

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ABSTRACT

The toxicity of commercial detergent was investigated with emphasis on oxidative stress using the common carp.To evaluate the detergent induced toxicity, the fish was divided into 5 different groups containing 12 fish in each group. Group-1 fish were designated as control. Group 2, 3 and 4 fishes were treated with 0.0075g/l, 0.0125g/l and 0.0175g/l concentrations of detergent respectively for 15 days. SOD and catalase enzyme activity changes were observed in kidney, heart and intestine of both treated and control fish. The findings of the study verify the detergent has a very high effect on biochemical properties of fish as detergent puts the fish under oxidative stress due to reduced antioxidant system.

KEYWORDS

Detergent toxicity, Enzymes Oxidative stress.

INTRUDUCTION

The problem of water pollution is too broad itself to warrant the attention and the solution of this problem requires the contribution of various disciplines. Lack of the understanding about biological events and observations to a large extent is one of the major reason for current environment situations (Dugan, 2012). Unregulated industrialization coupled with increased discharge or household wastes and other anthropogenic activities have triggered deterioration of water quality. A major gap has been found between the biodiversity and ecosystem function during the research when scientists tried to understand the effect of biodiversity loss on our ecosystem, and particulary the aquatic ecosystem is highly effected (Hooper, 2005; Covich, 2004; Gessner, 2004). According to the European Water Framework Directive the fish represents one of the basic element which evaluates the ecological status of rivers (Hermoso *et al.,* 2010). Different pollutants have many undesirable effects on the aquatic systems, but detergents are one of the major elements in the sewage, hence the study of its effects on aquatic organisms becomes important (Hedayati *et al.,* 2016).

Detergents penetrate into the cells of fish, that results in large production of ROS which cause genotoxicity and cytotoxicity(Shukla and Trivedi, 2017). In commercial detergents, the concentration of surfactants is between 10 to 20%. The other components in the detergents are bleach, builders, perfumes, stabilizer, dyes, optical brighteners which are designed to enhance the properties of surfactants (Swisher, 1975; Okpokwaskii and Nwabuzor, 1988).

Since, the surfactants have the capability to reduce the surface tension of water, this reduced surface tension makes it easier for aquatic organisms to absorb pesticides, and other pollutants from polluted water (Singh, 2014).). Surfactant metabolism by aquatic animals produce high ROS and cause oxidative stress (Hofer and Bucher 1997; Livingstone 2003; Wu *et al.,* 200; Mei Hui, 2008). Oxidative stress is defined as a product of an imbalance between the production of ROS and antioxidant defenses in the body of living organisms (Nishida, 2011).

MATERIALS AND METHODS

Present study was conducted on the kidney, heart and intestine of carp i.e. *Cyprinus carpio.* The experimental set up was done in fish farm Nalagarh ,H.P. India for 15 days. All the fish were maintained in water tank of approximately 1700 L capacity under natural conditions. Water tank was made free of any other pollutant. Detergent was obtained from local market of Shimla under trade name Surf excel. The LC_{50} Value of surf excel detergent to Catla catla and Rohu fingerlings were calculated as 14.2 and 11.06ppm respectively.(Jawahar *et.al.*,) Required quantity of detergent was dissolved in tank in which fish were kept. All experimental procedures were conducted after the approval of Department of Fisheries, Himachal Pradesh, India.

The fish were divided into 5 groups containing 12 fish in each group. The fish of group -1 were designated as control, group-2 were treated with 0.0075g/l concentration of detergent, group-3 fish were placed in 0.0125g/l concentration of detergent and group-4 fish were kept in 0.0175g/l concentration of detergent. Determined concentrations of detergent were dissolved in water tank for the period of total 15 days. The kidney, heart and intestine were extracted from normal and treated fish after 5,10 and 15 days and then further procedures were carried out.

Enzymes assay

SOD enzyme activity was determined by the method of Mishra and Fridovich, (1972). Catalase activity assay was done as per method of Aebi, (1984).

Table 1: Changes in SOD specific activity (units/mg protein) in normal and detergent treated kidney ,heart and intestine of *Cyprinus carpio* for 5-15 days at different concentrations of detergent.

Days	Control	0.0075	0.0125	0.0175
5days Kidney	13.31±0.09	14.21±0.02**	14.56±0.11	15.80±0.09**
10 days Kidney	10.27±0.09	11.17±0.02	11.52±0.11	12.76±0.09**
15 days Kidney	12.32±0.80	13.24±0.04**	13.62±0.11**	14.66±0.09**
5 days Heart	12.88±0.82	14.97±0.06*	15.86±0.12**	16.43±0.20**
10 days Heart	10.44±0.23	11.51±0.12*	12.46±0.20**	13.67±0.14**
15das heart	13.77±0.12	14.89±0.09*	16.01±0.17**	17.12±0.34**
5 days intestine	9.36±0.02	10.30±0.03**	10.55±0.07**	11.65±0.06**
10 days intestine	11.34±0.07	12.33±0.06**	12.61±0.09**	13.76±0.06**
15 days intestine	14.51±0.05	15.53±0.05**	15.71±0.09**	16.86±0.06**

Table 2: Changes in CAT specific activity (units/mg protein/min) in normal and detergent treated kidney ,heart and intestine of *Cyprinus carpio* for 5-15 days at different concentrations of detergent.

Days	control	0.0075	0.0125	0.0175
5days kidney	2.91±0.06	3.36±0.09*	3.72±0.06**	4.26±0.12**
10 days kidney	2.86±0.06	3.19±0.05	3.67±0.07**	4.09±0.10**
15 days kidney	3.12±0.11	3.34±0.13	3.81±0.08*	4.14±0.11**
5 days heart	4.76±0.08	5.62±0.09*	6.28±0.28**	6.39±0.08**
10 days heart	3.73±0.05	4.78±0.04**	5.12±0.07**	5.46±0.12**
15days heart	2.71±0.05	3.88±0.05**	4.07±0.04**	4.61±0.21**
5 days intestine	1.81±0.05	2.97±0.05**	3.22±0.08**	3.78±0.05**

10 days intestine	2.73±0.05	3.90±0.05**	4.27±0.08**	4.88±0.06**
15 days intestine	1.07±0.02	1.87±0.02**	2.99±0.08**	3.23±0.06**

RESULTS

Increased SOD-catalase activity level in the body of treated fish can help to understand the stress condition of fish. Maximum increase in SOD activity was at concentration 0.0175g/l and minimum increase in SOD activity at 0.0075g/l was observed in fish kidney after 5 days .SOD activity showed similar trend of maximum and minimum increase at 0.0175 and 0.0075g/l concentration after 10 and 15 days respectively. Changes in SOD activity in heart showed an increasing trend for all detergent concentration with maximum increased percentage at 0.0175g/l and minimum increase at 0.0075g/l Levels of SOD activity in intestine increased significantly after exposure of detergent (0.0075 to 0.0175g/l concentrations) for 5 to 15 days as in the earlier organs. An increasing trend of SOD activity is clearly shown in(Table 1). Maximum increase in CAT activity at 0.0175g/l was in fish kidney after 5 days and minimum increase in CAT activity at 0.0075g/l was 7.02% in fish kidney after 15 days. Minimum increase in CAT activity at 0.0075g/l was 18.06% in fish heart after 5 days while maximum increase in CAT activity at 0.00175g/l was 70.11% observed in fish heart after 15 days . Maximum increase in CAT activity at 0.0175g/l was 108.83% in fish intestine after 5 days. And minimum increase of 42.85% at 0.0075g/l in *fish* intestine after 10 days was observed(Table 2).

DISCUSSION

The SOD activities showed a marked increase in the kidney , heart and intestine with respect to the corresponding control organs of the *Cyprinus carpio* in our experiments. Similar results were observed in mussels where increase in the amount of SDS modified the activities of SOD. (Faria *et al.,* 2010; Vlahogianni *et al.,* 2007; .Increased amount of SOD due to high amount of SDS shows a correlation between two of these and suggests that how SOD is induced by SDS. This observation is also supported by Jifa *et al.,*(2005). According to this, the chronic exposure of SDS is responsible for the increase in SOD activities. An increasing trend of catalase activity has been shown in our experiment , this slow increase of catalase enzyme activity in kidney,heart and intestine of fish to sub-lethal expoure observed in our present study may be an adaptation to hydrogen peroxide generated by SOD activity, since catalase is the one that is responsible for the detoxification of H_2O_2 into water. Similar results were also seen in the mussel when exposed to SDS. The reason for the increased activity of catalase may be due to the availability of hydrogen peroxide in ample amount as a result of SOD activity. Hence it can be said that activity of CAT is directly triggered by SOD and depends on it (Messina *et al.,* 2014).

The similar trend of catalase activity is further supported by another study of (Thansi *et al.,* 2017) in which gills, liver and muscles showed a significant increase in the catalase activity when *Anabas* was exposed to a laundry detergent.

CONCLUSION

Enzymes activities are responsible for the chemical and biological reactions in fish. However, to obtain the toxic effects of detergents on fish a holistic study approach can be adopted such as hematological impacts, serum enzyme activity level, histopathological observations and also the alterations at gene level. The present study helps to understand that pollutants like detergent has a very disgusting effect on the biochemical constituents of the aquatic organisms .

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