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STUDY ON TOXICITY OF DIFFERENT CONCENTRATION OF HOUSEHOLD DETERGENT "TIDE" ON OXYGEN CONSUMPTION IN FRESHWATER FISH LEPIDOCEPHALICHYTHYES THERMALIS

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ABSTRACT

Water is one of the most important and precious element on the earth surface which is very essential for life. Lepidocephalichythyes thermalis is one of the most common edible fish available in the local market of Bhiwandi was selected in the present study to analyse the effects of tide detergent on oxygen consumption capacity of the fish in two sublethal concentrations. The amount of dissolved oxygen consumed by fishes was determined using Winkler's method. The average mortality (LC_{50}) was determined by Finney Probit Analysis. According to probit the 50% mortality values of detergent tide for 24, 48, 72 and 96 hrs were recorded as 42 mg/L, 39 mg/L, 36 mg/L and 32 mg/L respectively. The Fishes were exposed to sublethal concentrations (13 mg/L) $1/3^{rd}$ and (3.9 mg/L) $1/10^{th}$ the LC_{50} values of tide for 48 hrs. The oxygen consumption has fluctuated with both the sublethal concentration with increase in time.

KEYWORDS: Detergents, Tide, Dissolve oxygen, Lepidocephalichythyes thermalis, fish.

INTRODUCTION

Water is a widespread chemical substance that is very important for the survival of all known forms of life. Water pollution has become a serious problem throughout the world it is unfortunate that the rivers are being increasingly used as natural dustbin for discharge of all sorts of community and industrial wastes (Aravind kumar, 1995). The chemical nature of the environment has been greatly altering after the Second World War through the addition of thousands of chemicals such as pesticides, detergents, heavy metals, sewage and several other

wastes from different industrial units, drainage from cities and mills and changing lifestyle. Many of these chemicals show acute toxicities for a wide range of animals including human beings. The results from acute toxicity tests can provide information for comparison of toxicity and dose-response among members of chemical classes and help in the selection of candidate materials for further work (Hedayati et al., 2010). While others are not being so toxic to the living organisms but some of these are highly resistant to degradations in the environment and may accumulate within the body of the organisms including human beings causing adverse effects.

Freshwater, an essential element for all forms of life. On a global scale, human activities have created a number of environmental exertion of the hydrosphere. The withdrawal of freshwater from rivers, lakes, and underground reservoirs for human consumption has grown extremely since the later part of the 19th century. For agricultural purposes man uses chemical fertilizers, pesticides, insecticides which create a huge problem to the ecology and environment. The compositions of the sewage vary in space and time. Sewage contains human and animal excreta, food residues, cleaning agents, detergents and other wastes (Ananthakrishnan & Soman, 1988). An indicator of pollution in water is its amount of Dissolved Oxygen (DO). Dissolved Oxygen's presence in water is a positive sign, but low levels are a sign of severe pollution. Water with consistently high levels of DO is considered healthy and capable of supporting many different kinds of aquatic organisms. (Sharma and Miss, 1998). DO in water generally come from one of two sources. Most DO comes from the atmosphere and tumbling water mixes atmospheric oxygen.

Contamination of natural water by detergents has become a matter of concern in recent years because of their large scale use in home and industrial applications, such as, washing powders, dye tasters, formulation of shampoos, industrial and household cleaning agents, toothpaste, tooth powder, in dispersing oil spills etc. available reports point out that entry of detergents into aquatic system build up in the food-chain and are responsible for many hazardous effects and even death of the aquatic organisms, including fishes (Summarwar and Lall, 2013).

Detergents are used in all households for washing purposes. Detergents are not fully degraded even after sewage treatment and their discharge in to the river cause serious pollutions problems. Detergents can also be wetting agents which lower the surface tension of water and act as clearing agents. Enzymes present in detergent cause several types of allergies.

Phosphate in detergents favors the growth of algae which uses up most of the available oxygen in the water causing the death of aquatic organisms. (Dara S.S., 1993).

Synthetic detergents are a diverse group of compounds and part of a larger group known as surface-active agents or surfactants. In recent years there has been a rapid increase in the production of synthetic detergents which are used in industries and house hold purposes. These have become one of the important contributory substances that create pollution in natural water systems. Toxicological impacts of synthetic detergents have been well documented by many workers. The aim of the present study is to evaluate the effects of different concentration of detergent on dissolved oxygen consumption by fresh water fish Lepidocephalichythyes thermalis. This study is very influencial because nowadays domestic utilisation of detergents pollutes our fresh water ecosystem.

MATERIALS AND METHODS

The fresh water fish Lepidocephalichthyes thermalis, a common adible fish were collected from local market (Bhiwandi). They were immediately transported to laboratory condition. The tap water free from contaminants was used for the present study. The fishes were maintained in the aquarium tanks and acclimatized for a period of 4 weeks. The physico-chemical analysis of water used in the experiments was carried out using the standard method of APHA (1998). Physico-chemical parameters of the tap water used for the present study are as follows; Temperature 27 ± 1^0C, pH 7.4 ± 0.3, Alkalinity 139 ± 0.9 (mg/I), Salinity 0.3 ± 0.2 (ppt), Total Hardness 140 ± 0.5 (mg/I) were recorded during experimental period. The fishes were fed with commercial fish feed, once in daily and water was replaced every alternate days.

Detergents like Tide was weighed accurately as per requirement and dissolved in water before adding the fishes into the aquarium. For each set of experiment 5 moderate size fishes were selected for the experiment having length ranging from 3.9 ± 0.5 cm and weight ranging from 2.9 ± 1.5 gms of acclimatized fish from original stock. The average mortality in each concentration was taken to determine the LC_{50} by Finney (1971) Probit Analysis (Log concentration). According to probit the 50% mortality values of tide for 24, 48, 72 and 96 hrs were recorded as 42 mg/L, 39 mg/L, 36 mg/L and 32 mg/L respectively. The fishes were subjected to two different concentration (13 mg/L) 1/3^{rd} and (3.9 mg/L) 1/10^{th} of the calculated 48 hrs LC_{50} value (39 mg/L) of detergent for different exposure periods (24, 48, 72 and 96 hours). Simultaneously a control tank was also maintained. After each exposure

periods such as 24, 48, 72 and 96 hours, experimental weighed fishes were kept in various sublethal concentrations of detergents in an air tight glass jar for one hour. The oxygen consumption was estimated in ---mg/litre/gram of body weight by modified Winkler's method (Harish Kumar and Gujaria S.C, 1995).

RESULT

The present investigation was discussed the effect of detergent tide on Dissolve oxygen consumption of fresh water Lepidocephalichythyes thermalis on 24, 48, 72 and 96 hrs of exposure to sub-lethal concentrations 13 mg/L ($1/3^{rd}$) and 3.9 mg/L ($1/10^{th}$) with respect to control were presented in table no: 1. A slightly increase in oxygen consumption level was observed and compared to control (Figure 1).

Dissolved oxygen concentration indicated that the water samples collected for experiment contain sufficient amount of dissolved oxygen for the survival of the fish. As the sample was treated with sub-lethal concentration the significant change was observed in oxygen consumption. In control fish, the dissolve oxygen was 4.866±0.057 at 24 hrs, which was increased to 5.166±0.057 at $1/10^{th}$ conc. 3.9 mg/L and this value further inceased to 5.666±0.152 at $1/3^{rd}$ conc. 13 mg/L of detergent tide. Similarly, for 48 hrs, in control fish it was 4.566±0.057, which was increased to 4.766±0.057 at $1/10^{th}$ conc. 3.9 mg/L and this value further reduced to 4.366±0.057 at $1/3^{rd}$ conc. 13 mg/L. For 72 hrs, in control 4.133±0.152 value was found which increased to 4.533±0.305 which was again reduced to 4.166±0.057. A highly reduction in dissolve oxygen level was found in 96 hrs, in control it was found to be 3.833±0.057 which reduced to 3.733±0.208 and further reduction was found at higher concentration 3.466±0.152. This shows a fluctuation in dissolve oxygen consumption at 2 sub-lethal concentrations of detergent. Oxygen consumption with respect to the gram body weight exhibit a significant fluctuation in the consumption rate with respect to an increase in the concentration of detergent.

Table 1: Effects of Detergent Tide on Oxygen consumption in *Lepidocephalichythyes thermalis* at various sublethal concentrations.

Sr. No	Exposure in Hrs	Control	Conc. 13 mg/L	Conc. 3.9 mg/L
1	24	4.866±0.057	5.666±0.152	5.166±0.057
2	48	4.566±0.057	4.366±0.057	4.766±0.057
3	72	4.133±0.152	4.166±0.057	4.533±0.305
4	96	3.833±0.057	3.466±0.152	3.733±0.208

Values expressed as --mg/litre/gram of body weight.

The values in table are in the form of Mean ±Standard deviation.

Mean and standard deviation are the pool of three individual measurements. The difference between control and exposure period (in Hrs) were found to be statistically significant.

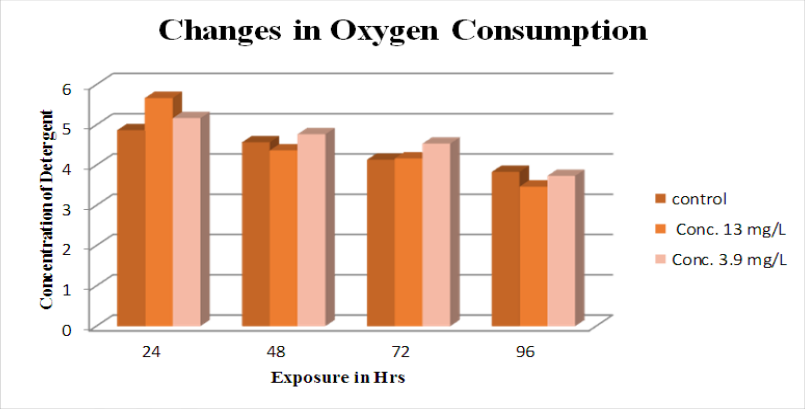

Figure 1: Effects of Detergent Tide on Oxygen consumption in *Lepidocephalichythyes thermalis* at various sublethal concentrations.

DISCUSSION

For present investigation, it was observed that the detergent had a severe impact on the experimental fish. The molecules of detergent penetrate and solubilize the lipid content of cell membrane and reduces its permeability. Gills are osmoregulatory organs in fishes and also a primary site of uptake for water borne pollutants. Therefore, gills are the first sites where the effect of pollutants would be observed, because of the swelling of gill epithelium it leads to decreased efficiency for gases exchange and oxygen consumption (Sudhasaravanan. R and Binukumari. S., 2015).

When experimental fishes were introduced into water containing detergent, at higher concentrations, they started showing discomfort within few minutes and began to move rapidly. Mystus montanus exhibited a variety of behavioural responses like opercular movement was 20-25 times more faster than controlled. Affected fishes were swimming on lateral side of the body; nervous control and equilibrium were lost. During tests, the test fish exhibited several behavioural changes before death such as restlessness, rapid swimming and respiratory distress. Similar results have been noticed by many workers.

Detergents cause impairment of chemoreceptor organ (Bardach et al., 1965) and damage to epidermis and pharyngeal wall. The oedema within the lamellar epithelium extends the blood water diffusion barrier, thus increasing the diffusional distance, or decreasing the diffusion

conductance of oxygen (Ellis A.G. and Smith D.G., 1983). Some studies of the pathological effects caused by chronic exposure to synthetic detergents evidenced the gradual destruction of the gills filaments, kills the fishes due to asphyxia (Misra et al., 1985). Gill damage is generally accepted as a cause of respiration difficulties and consequential death of many fishes (Zaccone et al., 1985). Detergents can also be wetting agents which lower the surface tension of water and act as a cleaning agent. Enzymes present in detergents cause several types of allergies (Dara, 1993).

Respiration was largely affected in presence of surfactants. The respiratory rate was increased in Lepomis machrochirus at concentrations above 1.56 ppm when exposed to alkyl ethoxylates was observed by Maki A.W. and W.E. Bishop (1979). A commercial detergent "Ariel" at 5ppm was found to induce moderate degenerative changes in the respiratory lamellae in Oreochromis mossambiccus on 2 days exposure and the chronic exposure led to drastic changes like separation of epithelium layer and atrophy (Raju C.S. *et.al*., 1994). The studies on fish Sparus aurata, found pronounced alteration in the filaments of individuals exposed to concentrations from 3 to 15mgL-1 of SDS and LAS. Ribelles A. *et.al*., (1995) noticed that when an extensive destruction of the metabolic surface of the gills occurs, there was a decrease of the entrance of oxygen in blood stream of the fishes, causing suffocation. The lamella's epithelial tissue got three times more swollen than normal due to edemas. Also, thickening of cellular walls was observed. In the shrimp Panaeus japonius exposed to 0.75mgL-1 of LAS-C12 for 96 hr that the secondary filaments of the gills were found to be fused due to necrosis of the cells (Supriyono E. *et.al*., 1998).

Dissolved oxygen and viscosity are factors affect the oxygen consumption and swimming capacity of fish. Such factor could be related to the swelling of the gills that would be hindering the passage of oxygen. However, for short periods of exposure to the polluting agent, a maximum of one and a half hour, an increase was observed in the specific consumption of oxygen (Barbieri Edison, 2007). In case of toxicity of detergents, the fish would decrease the tolerance to low concentrations of dissolved oxygen (Huang B.Q. and Wang D.Y., 1994).

CONCLUSION

Nowadays, more or less all households use detergents for washing purposes and in most cases; the sewage water is discharged into the water bodies. People need to be made aware of the adverse causalities of detergents on different forms of aquatic life. Sewage water

generated from households should not be sanctioned to discharge directly into the water bodies. Better sewage treatment facilities have to be looked into for the fortification of these water bodies.

The present investigation revealed that detergent incorporated in water created a disturbance in Oxygen consumption. A fluctuation was observed in dissolve oxygen consumption of fresh water fish Lepidocephalichythyes thermalis exposed to short term exposure periods of detergent tide, as compared to the control. With the various concentration of detergents fishes shows different types of behavioural changes, like sluggish swimming, extreme discharge of mucus over gill filaments, irritation of gill epithelium which can vary and obstruct in respiration, reduced gill diffusing capability result in increase or decrease in oxygen consumption.

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