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EFFECT OF DIFFERENT CONCENTRATIONS OF DETERGENT ON DISSOLVED OXYGEN CONSUMPTION IN LEPIDOCEPHALICHYTHYES THERMALIS

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ABSTRACT

The detergents are household chemical cleaning compound required in wide range of our daily life for diverse purposes. In many of these of application, the surfactants are used in interaction with water. Surfactant is a major constituent of detergents; this is a compound of high biological activity and has a tendency to accumulate in organisms, making adverse effects possible even at very low levels of exposure. In some rivers the concentrations of detergents is quite high. Three different concentrations of a popular brand of detergent were prepared and the amounts of dissolved oxygen consumed by fishes exposed to the detergent were determined using Winkler's method. Our study demonstrated that dissolved oxygen consumption in *Lepidocephalichthyes thermalis* increases in the presence of detergent. This is due to the stress caused by the detergent on the normal physiological activities of the fish. Draining of domestic sewage containing detergents into water bodies adversely affect its aquatic fauna.

KEYWORDS: *Lepidocephalichthyes thermalis*, Detergent, Dissolved Oxygen, Fresh water, Stress.

INTRODUCTION

Pollutant acts as physiological stress or for exposed organisms as do the environmental parameters.[1] Thus detergent stress apparently leads to higher metabolic rate which require

an additional expenditure of energy. This increased energy demand perhaps interferes with the enzymatic systems of the metabolic pathway as well. The increasing use of synthetic detergents in place of soap work authorities' river foam caused by the presence of even low concentrations of these detergents. Oxygen consumption is a measure of the metabolic state of the animal. Hence it is considered as vital parameters and indicates the physiological & metabolic alteration as the animal. It is known that the respiratory roles alter under the influence of a several biotic and abiotic factors.[2] Surfactants are known to cause gill damage.[3] Fish gills are well known to be a multifunctional tissue involved in not only respiration, but also osmoregulation. Gill damage is generally accepted as a cause of respiration difficulties and consequential death for many fishes.[4,5] An LC50 mortality probability value was first determined[6], then the gill damage was diagnosed by the morphometry method.[7] Oxygen consumption curve will finally be recorded for measuring the respiratory rate, lethal oxygen concentration and survival time With the wide spread use of synthetic detergents for household purpose, it is inevitable that these compounds would find their way into rivers and ponds. The effect of detergents on tissue of different fishes have been studied by.[8] Gills, a primary site of osmoregulation, as well as respiration, may be highly vulnerable to lesions because they are in immediate contact with aquatic toxicants. Destruction of the gill epithelium is regarded as a consequence of the reduction of surface tension by the presence of surfactants.[9] Detergent causes impairment of chemoreceptor organs[10] and damage to epidermis and pharyngeal wall.[11]

MATERIALS & METHODS

2.1. Experimental setup: Study fishes were collected from a fish hatchery. Young fishes averaging 10g were selected. Water samples for the experiment were collected from a relatively unpolluted pond. Three different concentrations (100ppm, 500ppm and 1000ppm) of the popular detergent, 'Tide' was prepared in the sample water. Dissolved Oxygen (DO) content of the sample water was estimated using Winkler's method. Transferred a fish each into three jars with the said concentrations of the detergent and kept for one hour. Similarly three control jars with 100ppm, 500ppm and 1000ppm detergent were kept as controls. After one hour, water samples were collected from the six jars using siphon and estimated their DO content employing Winkler's method. Difference between the amounts of DO in the sample with only detergent and that with both detergent and fish gave the amount of DO consumed by the fish for that particular concentration of detergent. Similarly, DO consumed by fishes in other water samples was calculated. All experiments were repeated 5 times.

2.2. Estimation of Dissolved Oxygen (DO): Water sample for estimation after the experiment was taken in 250 mL bottles taking care to reduce the contact of this water to air and not to induce any air bubble in the sample bottle. The bottle was closed with a stopper. 1 mL of Manganous sulphate and 1 mL of alkaline iodide were poured into the bottle using separate pipettes. Shook well and allowed to settle down. Shook the bottle again and 2 mL of concentrated Sulphuric acid was added to this mixture and shook vigorously to digest the precipitate. 50 mL of this solution was pipetted out into a conical flask. It was then titrated against Sodium Thiosulphate solution taken in the burette until the brown colour of iodine almost disappeared. To this, added 5 drops of starch solution. The end point was marked by the first complete disappearance of blue colour.

RESULTS

Dissolved Oxygen in the water sample was estimated before adding the detergent or introducing the fishes and the values averaged at 9.71 mg/L. This reading was taken as the control. DO concentration near to 10 mg/L indicated that the water sample collected for the experiment contained sufficient amount of dissolved Oxygen for the survival of fishes. Sample water treated with 100 ppm of detergent for 1 hour showed a mean decrease in DO of 0.19mg/L from the control. With increased concentration of detergent at 500 ppm for 1 hour, DO further decreased by 0.51mg/L from the control. This trend continued also with the sample water treated with a detergent concentration of 1000 ppm for 1 hr. where a mean decrease in DO of 0.83 mg/L from the control was noted. This decrease in DO content of sample water treated with detergents was due to the presence of Phosphates in detergents which readily react with dissolved Oxygen.

When experimental fishes were introduced into water containing 100 ppm of detergent, they started showing discomfort within 10 minutes and began to move around rapidly. With increased concentrations of the detergent at 500 ppm and 1000 ppm, the time lag for rapid movements reduced to around 5 minutes and 2 minutes respectively. However, in all the experiments, the fishes appeared inactive later and rested at the bottom of the vessel. But, they continued to breathe rapidly and the mucous on the body surface started to come off . This phenomenon was more manifest in the water with 1000 ppm detergent. Estimation of DO consumed by the fishes showed an increasing trend with the increase in concentration of the detergent.

Table: 1- Dissolved Oxygen Levels under Different Treatments

Concentration of Detergent	DO (mg/L) Detergent alone	DO (mg/L) Detergent & Fish	DO (mg/L) consumed by Fish	DO consumption (mg/L/hr/g body wt.)
0 ppm	9.71	7.01	2.7	0.26
100 ppm	9.52	6.32	3.2	0.31
500 ppm	9.2	5.36	3.84	0.39
1000 ppm	8.88	3.5	5.38	0.53

DO- Dissolved Oxygen (All treatments were of 1 hour duration and the values are Arithmetic Mean of 5 independent experiments)

Fishes used in control experiment (with no detergent added) showed a DO consumption of 2.7mg/L/hr. Fishes kept at 100 ppm of detergent concentration showed a mean DO consumption of 3.2mg/L/hr. With the detergent concentrations at 500 ppm and 1000 ppm, the mean DO consumption reached 3.84 mg/L/hr and 5.38 mg/L/hr respectively. All the experimental fishes weighed between 9.8 g and 10.3 g. Mean DO consumption per gram body weight of the fishes used in the experiments were calculated and is shown in the last column of Table 1. This data also indicates an increased consumption of DO by the fishes under increased concentrations of the detergent. Figure: 1- Dissolved Oxygen Consumed by Fishes at Different Concentrations of the Detergent The fishes were surfacing frequently. 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. Opercula ventilation rate as well as visual examination of dead fish indicates lethal effects of the detergent on the fish.

DISCUSSION AND CONCLUSION

From this experiment it is observed that the detergent had a severe impact on the experimental fish.. With increase in concentration of the detergent, increased breathing and signs of distress were exhibited by the fish. Soaps and detergents are the main cleansing agents used in households. Most of the ingredients of soap are biodegradable, but that of detergents are not biodegradable. Hence detergents cause more water pollution than soap. In areas like Kuttanad, where most households are by the banks of rivers and canals, waste water is often expelled into the water bodies. During earlier times when the use of detergents was not so prevalent, people relied on soaps for washing purposes. This might not have created much distress to the aquatic fauna. But nowadays almost 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 various forms of aquatic life. Sewage water generated from households should not be allowed to be discharged directly into the water bodies. Better sewage treatment facilities have to be looked into for the protection of these water bodies. The swelling process would inhibit the passage of oxygen from the water to the bloodstream to the fish, causing it to consume less oxygen.

The detergent molecules can penetrate and solubilize the lipid content of cell membrane and may reduce its permeability. Gills are osmoregulatory organs in fishes and are 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. Toxic elements of detergents also cause excessive secretion of mucus over gill filament and irritation of gill epithelium which can alter and interfere in respiration as well as reduced gill diffusing capacity, resulting in decrease or increase in oxygen consumption. Oxygen consumption decreases with an increase in concentration and time of exposure and may be due to penetration of the pollutants at sub-cellular levels, and ii. damage of gill tissues. In oxygen consumption has increased with low sublethal concentration (1/3rd) of both detergents with increase in time may be due irritation of gill epithelium, movement of gills was observed faster. Whereas with 2/3rd sublethal concentration of both detergents, significant decrease in oxygen consumption with an increase in time was noticed from 48hours of exposure due damage if gill tissue after two days exposure.

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