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An evaluation of the effect of a detergent on dissolved oxygen consumption rate of *Anabas testudineus*

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Abstract

Water is one of the nature's most important gifts to mankind and that is very essential for the sustenance of life. *Anabas testudineus*, a common fresh water fish in Kerala was selected in the present study to determine the effect of detergent pollution on the oxygen consumption capacity of the fish in four different concentrations of a popular brand of detergent (sunlight). The amount of dissolved oxygen consumed by fishes were determined using Winkler's method. The study demonstrated that dissolved oxygen consumption in *Anabas testudineus* increases with an increase in the concentration the of detergent. This is due to the stress caused by the detergent on the normal physiological activities of the fish. The study indicated that the draining out of domestic sewage containing detergents into the water bodies will adversely affect its aquatic fauna leading to cultural eutrophication. There is an urgent need of providing environmental education among the common people to avoid these thoughtless deliberate actions thereby aiming at sustainable development.

Keywords: Detergents, eutrophication, sewage, surfactants, phosphates, Dissolved oxygen (DO) etc.

1. Introduction

Freshwater, an essential element for all forms of life. On a global scale, human activities have created several environmental problems of the hydrosphere. The withdrawal of freshwater from rivers, lakes, and underground reservoirs for human consumption has grown tremendously since the later part of the 19th century. For agricultural purposes man uses chemical fertilizers, pesticides, insecticides which create great 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 (Ananthkrishnan & Soman, 1988) ^[1]. Detergents that contain phosphate are highly caustic, and surfactant detergents are very toxic. They are widely used in daily activities and these detergents cause excess frothing and growth of floating aquatic weeds (eutrophication) on the water surface, affecting aeration and quality of fresh water. This adversely affects the physiological and biochemical processes of fish, number of factors such as temperature, pH, salinity, turbidity and so on affecting the dissolved oxygen content as well as the oxygen consumption by the fishes. The synthetic detergents can alter pH and salinity of receiving freshwater bodies, which affect oxygen consumption by aquatic organisms including fishes (Chandanshive, 2013) ^[3].

Anabas is a genus of climbing gouramis native to southern and eastern Asia. In the wild, *Anabas* species grow up to 30 cm long. They inhabit both brackish and fresh water. *Anabas* species possess a labyrinth organ, a structure in the fish's head which allows it to breathe atmospheric oxygen, so it can be out of water for an extended period of time (6-8) hours. They are carnivores, living on a diet of water invertebrates and their larvae, and they guard their eggs.

The present study is an evaluation of the effect of different concentration of a detergent on dissolved oxygen consumption by *Anabas testudineus*. In air breathing fish *Anabas testudineus*, dissolved oxygen consumption increased when it was exposed to the water containing detergent. With an increase in the concentration of the detergent, the breathing rate increased and signs of distress were exhibited by the fish. Even though *Anabas testudineus* is very sturdy in tiding over stressful environment, presence of detergents proved detrimental. This study is very influential now a day because domestic utilisation of detergents pollutes our fresh water ecosystem.

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2. Materials and Methods

Fish samples for the study (*Anabas testudineus*) was collected from Alappuzha district and the weight of the fish was recorded. Water samples for the experiment were collected from aquarium tank. Four different concentrations (50ppm, 100ppm, 150ppm, 200ppm) of the popular brand of detergent were prepared in the sample water. Dissolved oxygen content of the sample water was estimated using Winkler's method. Transferred the fishes each into four jars with the above said concentration of the detergents and kept for one hour. Similarly four jars of that different concentrations of detergents were kept as controls. After one hour, water samples were collected and estimated their DO content by 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 the particular concentration of detergent.



Fig 1: *Anabas testudineus*

3. Result and Discussion

Table 1: Oxygen Consumption of *Anabas testudineus* exposed to various concentration of detergent (Sunlight)

Concentration of Detergent (Sunlight) (ppm)	Dissolved Oxygen (mg/l) (Detergent alone)	Dissolved Oxygen (mg/l) (Fish & Detergent)	Dissolved Oxygen consumed by fish (mg/l)	Oxygen consumption (mg/l/hr/g body weight of fish)
0 ppm	8.8	6.1	2.6	0.33
50 ppm	8.12	5.11	3.01	0.37
100 ppm	7.85	4.14	3.71	0.46
150 ppm	7.23	3.26	3.97	0.49
200 ppm	6.14	1.5	4.6	0.57

Dissolved oxygen in the water (taken from aquarium) was estimated before adding the detergent or introducing the fish of nearly 8 gram (*Anabas*) and the values averaged 8.8mg/l. This value was taken as the control. 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 50ppm, 100 ppm, 150 ppm, 200 ppm of detergent for a time period of 1 hour, the dissolved oxygen content showed a decreasing trend ranging from 8.12 mg/l, 7.85 mg/l, 7.23 mg/l, 6.14 mg/l (Table 1). Detergents are composed of complex phosphates which eventually breakdown into phosphates usable by aquatic plants. The use of detergents has been responsible for the increase in the phosphorous in sewage effluents. Phosphate pollution of rivers and lakes causes extensive growth of algae which depletes the dissolved oxygen content of water and disrupts the natural food chains. On treating the fishes with different concentrations of detergents they exhibited a state of inactive nature with an increase in the rate of breathing with the secretion of mucous. Oxygen consumption rate in the control bottle was 2.6 mg/l. At a concentration of 50 ppm, the oxygen consumption rate was 3.01 mg/l. The rate was shown in an increasing trend of 3.71, 3.97, 4.6 mg/l respectively for concentrations 100, 150, 200 ppm. Above that concentration fish exhibited a decline in the rate of survival. Oxygen consumption with respect to the gram body weight also exhibited an increase in the consumption rate with respect to an increase in the concentration of detergent.

Anabas has the habit of migrating from pond to pond. When in water, the fish frequently comes to the surface to breath air. This air swallowed by *Anabas* is taken into two chamber situated one on each side above the gills, forming outgrowth from the ordinary brachial chambers, richly supplied with fine blood vessels and covered with thin epithelium. Presence of accessory respiratory organ helps *Anabas* survive in water low in oxygen level (Norman, 1975) [7]. Detergents cause

impairment of chemoreceptor organ (Bardach *et al.*, 1965) [2] and damage to epidermis and pharyngeal wall. 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) [6]. Gill damage is generally accepted as a cause of respiration difficulties and consequential death of many fishes (Zaccone *et al.*, 1985) [8]. Detergents are not fully degraded even after sewage treatment and their discharge in to the river causing serious pollution problems. 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) [4]. Those studies are in agreement with the findings of the present study. In air breathing fish *Anabas testudineus* dissolved oxygen consumption increased when it was exposed to the water containing detergent. With increase in the concentration of the detergent, increased the breathing and signs of distress were exhibited by the fish. Even though *Anabas testudineus* is very sturdy in tiding over stressful environment, presence of detergents proved detrimental. The study goes in conformation with the findings of Emi Mathew *et al.* (2013) [5].

4. Conclusion

From this experiment it is emphasised that the detergents had a severe impact on the experimental fish (*Anabas testudineus*). Even though *Anabas* has wide respiratory capacity than the other fresh water fishes due to the presence of additional respiratory organ, it's dissolved oxygen consumption raised when it was subjected to the water containing detergent. With increasing concentration of detergent fish exhibited laboured breathing and signs of distress. Slow swimming activities were also observed. Above a concentration of 200mg/L of detergent proves lethal to the fish. The study points out the fact that indiscriminate use of the detergents and draining out them into these natural water bodies converting them into sewage

drainers has to be avoided by avoiding thoughtless actions. The current scenario can be treated by better sewage treatment facilities and awareness of people or public about the adverse effect of detergents on various form of aquatic life. Now a day the technology is improved so that biodegradation of detergents is also possible thereby reducing the impact of cultural eutrophication.

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