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EFFECT OF AN ORGANOPHOSPHOROUS PESTICIDE (DIMETHOATE) ON OXYGEN CONSUMPTION OF THE FISH *TILAPIA MOSSAMBICA*

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Abstract

Impact of sub lethal concentrations of pesticide dimethoate on oxygen consumption of *Tilapia mossambica* is reported. The rate of oxygen consumption of the fish was studied under the concentrations of 0.15ppm, 0.2ppm, 0.3ppm and 0.6ppm under 1/20, 1/15, 1/10, and 1/5 of sub lethal concentration respectively during the 24, 48,72 and 96 hours of exposure. The initial elevation in the oxygen consumption could be explained in terms of acceleration of oxidative metabolism during the initial hours of exposure, as a result of sudden response to the toxic stimulus of pesticide. The present study reveals that the pesticide dimethoate is toxic to the fish, *Tilapia mossambica* and even low concentration of dimethoate stress create respiratory disturbance which ultimately leads to the deterioration of general health of the fish.

Key Words: *Tilapia mossambica*, Dimethoate, Oxygen consumption.

Introduction

Water is one of the precious liquid of the natural resources available. A plentiful supply of clean water is essential for survival of human being, plants and animals. The disposal of industrial and agricultural waste directly into aquatic medium burdens the ecosystem [1]. Environmental pollution is one of the undesirable side effect of industrialization and an important aspect of environmental degradation. The pollutants associated with the industrial effluents are organic matter, inorganic dissolved solids, fertilizers, thermal constituents in the form of heat suspended solids, microorganisms and pathogens. Among these pollutants, organic pollutants decrease the level of dissolved oxygen in the water bodies. The disposal of these waste materials or waste water leads to contamination of rivers, lakes, and chronically affects the flora and fauna [2]. The exotic organic chemicals include surfactant in detergents, pesticides, various industrial products and the decomposition products of other organic compounds. Many of this are non-biodegradable and are degraded only at very slow rate. Some of these compounds have been found to be toxic to fish at very low concentration [3].

Presence of pesticide in streams and lakes is largely due to the runoff from agricultural fields and outfall from pesticide manufacturing factories [4]. Pesticides are not highly selective but are generally toxic to many non-target organisms. The aquatic environment is also polluted by pesticides and it leads to many changes in organism physiology [5]. The effect of endosulfan on oxygen consumption of fresh water fish *Lipidocephalicthys thermalis* was studied by several scientists [4,6] reported the effect of organophosphorous pesticide on oxygen consumption and heamatology of the fresh water fish *Oreochromis mossambicus*. This paper reports the impact of organophosphorus pesticide on oxygen consumption of the fish *Tilapia mossambica*.

Materials and Methods

The fish, *Tilapia mossambica* (weight 4-8g, length 4-7 cm)were subjected to preliminary tests with various concentrations of dimethoate which is commonly used pesticide in and around the Coimbatore against various pests. From the observations LC_{50} of Dimethoate to the fish *Tilapia mossambica* (3ppm at 24 hours) was determined.

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Further, the fishes were exposed to sublethal concentrations of 0.15ppm, 0.2ppm, 0.3ppm and 0.6ppm Dimethoate for varying periods 24,48,72 and 96 hours of exposure. The selection of concentration was 1/5,1/10,1/15 and 1/20 of the LC_{50} of Dimethoate. Changes in the rate of oxygen consumption of the fishes exposed to the four sublethal concentration of the pesticide was evaluated at different exposure periods. Suitable control was maintained. The rate of oxygen consumption was estimated by Winkler's method [7]. The results were in ml/g/hour.

Results and Discussion

The physical and chemical characteristics of water used for study were always found to be within the permissible limits of APHA [8]. The rate of oxygen consumption of fresh water fish *Tilapia mossambica* exposed to different sub lethal concentration of Dimethoate for 24,48,72 and 96 hours of exposure are shown in the Table.1.It was noted that the oxygen consumption of control fish were 0.242±0.03, 0.445±0.04, 0.473±0.035 and 0.453±0.03 ml/g/hr at for 24, 48, 72 and 96 hours respectively.

Table.1 Rate of oxygen consumption (ml/g/hr) of *Tilapia mossambica* in different concentrations of Dimethoate under sublethal toxicity at different times of exposure

Time of exposure (Hrs)	Concentration of Dimethoate							
	0.15ppm		0.2ppm		0.3ppm		0.6ppm	
	Control	Treated	Control	Treated	Control	Treated	Control	Treated
24	0.424±0.03	0.522±0.03	0.424±0.03	0.507±0.02	0.424±0.03	0.352±0.04	0.424±0.03	0.282±0.03
48	0.445±0.04	0.544±0.04	0.445±0.04	0.450±0.04	0.445±0.04	0.393±0.02	0.445±0.04	0.279±0.06
72	0.473±0.035	0.544±0.039	0.473±0.035	0.474±0.036	0.473±0.035	0.393±0.073	0.473±0.035	0.279±0.048
96	0.453±0.036	0.524±0.037	0.453±0.036	0.485±0.023	0.453±0.036	0.379±0.050	0.453±0.036	0.560±0.053

The oxygen consumption of fish exposed to the Dimethoate concentrations of 0.15ppm, 0.2ppm, 0.3ppm and 0.6ppm were obtained to be 0.522±0.03, 0.507±0.02, 0.352±0.04 and 0.282±0.03ml/g/hr respectively during 24, hours of treatment. The maximum oxygen consumption was observed at 0.15ppm whereas the minimum content was recorded at 0.6ppm.

The fish exposed at 24 hours of treatment showed elevated levels of oxygen consumption. The values were found to be 0.544±0.04, 0.450±0.04, 0.393±0.02 and 0.279±0.06 ml/g/hr in Dimethoate concentrations of 0.15ppm, 0.2ppm, 0.3ppm and 0.6ppm respectively. The minimum consumption was observed at 0.15ppm whereas the maximum was at 0.6ppm.

At 72 hours of exposure, the values showed a decline in the rate of oxygen consumption. Concentrations of 0.15ppm, 0.2ppm,0.3ppm and 0.6ppm depicted a reduction in the oxygen consumption of 0.544±0.03, 0.474±0.03, 0.393±0.07 and 0.279±0.04 ml/g/hr respectively. The oxygen consumption was higher in 0.15 ppm than the other concentrations.

The rate of oxygen consumption was higher than control in the Dimethoate concentrations of 0.15ppm, 0.2ppm, 0.3ppm and 0.6ppm whereas it was lower than the control in the concentration of 0.3ppm during 96 hours of exposure. The values noted were 0.524±0.03, 0.484±0.02, 0.0379±0.05 and 0.0560±0.05 ml/g/hr in the sub lethal concentration of 0.15ppm, 0.2ppm, 0.3ppm and 0.6ppm respectively.

The rate of oxygen consumption was observed in the sublethal concentration of dimethoate at different exposure periods. Dharmalata and Namitha Joshi [9] reported that the respiration is a vital phenomenon of the life and the rate of oxygen consumption in turn controls the metabolic activities and changes in respiratory rates have been used as the indicator of the stress in pollutant exposed organisms. In the present study, the oxygen consumption was gradually decreasing with increasing exposure periods as observed by Mathivanan [10] in *Oreochromis mossambicus* exposed to sublethal concentarations of Quinolphos. The rate of oxygen consumption was significant over control in all the exposure periods.

During the study, the rate of oxygen consumption increased in the lower concentration and decreased in the higher concentration as reported earlier by several scientists [11] in the toxicant exposed fishes. According to Rao [12] pesticides are known to stimulate the peripheral nervous system, as a result activity of fish increases which requires more oxygen to fulfill the energy demand. This could be the reason for initial elevation in the rate of oxygen consumption. In sub lethal medium, the respiration rate of fish decreased in the subsequent period of exposure which might be due to acclimatization of the fish in the chemical environment.

The intimate contact of gills with toxicant may lead to defection of normal respiratory area that is damage of gill tissue which in turn may reduce the diffusion capacity of the gill leading the depression in oxygen uptake [13]. The damage of gill epithelium due to pesticide have been observed and reported by Nagarathnamma and Ramamurthy[14].

Toxicants in the environment mainly enter into fish by means of their respiratory system [15]. A mechanism of

toxicant uptake through gill probably occurs through pores simple diffusion and is then absorbed through gill membranes [16]. From the results obtained, it is clearly evident that Dimethoate affect the oxygen consumption of Tilapia mossambica under all exposed concentrations. The observed increased in oxygen consumption by the whole animal may be due to respiratory distress as a consequence of the impairment of oxidative metabolism.

Several authors [17, 18, 19, and 20] reported that the disturbance in oxidative metabolism leads alteration in whole animal oxygen consumption in different species of fish exposed to pesticides. The alternative reasons for the elevation of oxygen consumption would be due to the internal action of Dimethoate. The present investigation is in confirmation with the trend observed in earlier investigation of above authors.

In the present study the initial elevation in the rate of respiration could be explained in terms of acceleration of oxidative metabolism during the initial hours of exposure, as a result of sudden response to the toxic stimulus of the pesticide. With the onset of symptoms of poisoning ,the rate decreased in the later periods of exposure, probably due to acclimatization to the chemical environment. Such observations were also made in studies on Ophiocephalus punctatus by Sambasiva Rao et al. [21] and on fingerlings of *Cirrihinus mrigal* by Rajamannar and Manohar [22] exposed to pesticides. The results of the present study confirm the earlier reports on oxygen consumption by fish in pesticide mixed water.

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