A Study on Oxygen Consumption in Freshwater Fish *Labeo Rohita* Exposed to Lethal and Sub Lethal Concentrations of Ethion 50%Ec

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Abstract

The pesticide pollution different classes like organochlorines, organophosphates, carbamates and other new generation ones affect the fish oxygen consumption in sublethal concentrations. Respiratory responses to lethal concentrations increase the ventilation volume and symptoms of pesticide intoxication suggesting that the effect on respiratory surface were high in fish. Hence, in the present study an attempt has been made to study the effect of lethal(1.2µg/l) and sub-lethal 1/10(0.12µg/l) LC_{50} and 96hrs of 50% mortality concentrations of Ethion 50% EC an Organophosphate effect on oxygen consumption for 24 h at each 2 hours interval to the Indian major carp, Labeo rohita (Hamilton). Oxygen consumption of aquatic animals is a very sensitive physiological process and therefore, alteration in the respiratory activity is considered as an indicator of stress of animals exposed to pesticides. The significant drop in the rate of oxygen consumption was observed in the present study in lethal and sub-lethal concentrations.

Keywords: *Ethion 50%EC, Labeo rohita, Lethal and sub lethal concentrations, O_2Consumption*

Introduction

Oxygen consumption plays a major role in the physiology of fish and it is also an index of its metabolic rate. Various factors like size, temperature, stocking density, seasonal variation[1] physiological factors and starvation influence oxygen consumption in fish. Besides this, various constituents of medium also affect oxygen consumption and fish absorbs oxygen directly from the water into their blood stream using their gills. Oxygen stress is a common cause of disease outbreaks the amount of oxygen in water decreases as temperature and altitude increases. As temperatures increases, fish metabolism also increase. Hence, they consume more amount of oxygen and the increase in temperature leads to increase fish metabolism causes oxygen depletion in the summer.

Fish have long been valued as an excellent indicator of water pollution and oxygen consumption is a very sensitive physiological process and the change in respiratory activity has been used as an indicator of stress in animal exposed to toxicants. Hypoxia caused significant increase in haemoglobin, haematocrit and mean corpuscular haemoglobin concentration[2,3]. The physiological and behavioral alterations occur in fishes in the absence of sufficient oxygen. The fishes were affected, either directly through uptake from the water, or indirectly through their diet vegetation, invertebrates or smaller fish[4].

The rate of oxygen consumption is considered as a reflection of the total metabolism and metabolic rate of the aquatic organisms. The water current flows around the gills; carries the toxicants directly, before that of all other internal organs. The changes in oxygen uptake is

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widely used in physiology as a biological indicator that integrates the overall metabolic activity of an animal in response to specific environmental stress factors because it reflects the energy expenditure and, ultimately, the food requirements. The changes in the respiratory activity of fish have been used by several investigators as indicators of response to pesticides[5]. The oxygen consumption is a useful measure of sub-lethal effects because energy processes being disturbed are indicators of overall physiological state and of pesticide poisoning leading to respiratory distress which is used to assess the toxic stress.

The O_2 consumption is a very sensitive physiological process and the change in respiratory activity has been used as an indicator of stress in animals exposed to toxicants[6]. The oxygen consumption is not often used as a bioindicators of pollution associated stress in biological early warning systems. Respiratory responses were found to be less sensitive, but also could be successfully used in bioassay testing of treated industrial and municipal effluents, before they are discharged into receiving waters. In the gill epithelium, the tissue will have intracellular and extracellular exchange of ions related to oxygen and chloride shift any xenobiotics chemical having the capacity to alter this structure will affect the oxygen carrying capacity of haemoglobin and reduction in oxygen uptake. The gill damage observed in fish exposed to toxicant was due to impairment in the respiratory metabolism. This is also due to the fact that any pollutant including pesticide should enter into the fish, mainly through the gills only[7].

The metallic pollution and pesticides of different classes like organochlorines, organophosphates, carbamates and other new generation ones affect the fish oxygen consumption in sublethal concentrations. Respiratory responses to lethal concentrations increase the ventilation volume and symptoms of pesticide intoxication suggesting that the effect on respiratory surface were high in fish[8]. Hence, in the present study an attempt has been made to study the effect of sub-lethal and lethal concentrations of Ethion 50% EC on oxygen consumption for 24 h at each 2 hours interval to the Indian major carp, *Labeo rohita* (Hamilton).

Material and Methods

The fish Labeo rohita were brought from local fisheries forms of Kuchipudi, Guntur (DT). The experiment on the oxygen consumption of the fish Labeo rohita was carried out in a respiratory apparatus developed [9]. The fish were acclimatized to the laboratory conditions in well aerated water for 7 days, used in the toxicity experiments (Table. 1). During this period, the fish were regularly fed with add libitum, but the feeding was stopped before two days prior to the experiment. The fish measuring 6 to 7 ± ½ cm in length and 6 to 8 ± ½ gm in weight, all the precautions laid down on recommendations of the toxicity tests to aquatic organisms are followed[10] and the method was used to estimate O_2 levels in lethal and sub lethal concentrations[11].

Results and Discussion

Present study O_2 consumption of fish Labeo rohita exposed to Ethion 50%EC. 0hr in control (0.892), in sublethal (0.880) and lethal concentration was in (0.846) and sublethal (0.952) lethal (8.18) respectively and 6hrs O_2 consumption in control (0.718) and sublethal (1.360) lethal (0.712) i.e sudden change in O_2 consumption levels were observed in the sublethal concentrations to compare with lethal concentration after other hrs the O_2 consumption levels were gradually decreased in all exposure of the fish Labeo rohita.

The whole animal oxygen consumption of control and experimental fish, calculated per gram wet body weight in sub-lethal and lethal concentrations of Pesticide Ethion 50% EC commercial grade for Labeo rohita. The results of the experiments and values are graphically represented by taking time on X-axis and the amount of oxygen consumed per gram body weight on Y-axis, in the fig.

Oxygen consumption measurements provide a robust indicator of whole animal stress and concomitant water quality. Respiratory rate is the basic parameter, and serves as one of the indicators of environmental stress[12]. Gills are the major respiratory organs and all metabolic pathways depend upon the efficiency of the gills for their energy supply and damage to these vital organs causes a chain of destructive events, which ultimately lead to respiratory distress[13,14]. Oxygen uptake rate would rapidly decreased[15].

In the present study sub-lethal concentrations of Ethion 50% EC; it was observed that fish Labeo rohita showed tendency of increase in oxygen consumption during the initial time of exposures i.e. 1 to 6 hours and a gradual decrease was observed during the subsequent period of study. The sub-lethal concentration of toxicants is inevitable. In such a case, the fish Labeo rohita was more sensitive to toxicant. The toxicant stress in oxygen consumption along with depletion in oxygen in aquaculture practices make them less fit and reduction in growth due to lack of proper metabolism. The fish was in more stress during first hour and later they are showing signs of recovery. That recovery is evident as the toxicant exposure is increased in time, during 24 hrs experiment.

A comparison is made between the effects of lethal concentrations of Ethion 50% EC on Labeo rohita decreased in oxygen consumption was observed. Hence, it has sensitive on toxic stress as a result of more oxygen consumption and the results were compared with other researchers. In controls also, the rate of oxygen consumption was gradually decreased and this can be attributed to the starved conditions and the reduced metabolic rates of the starved fish. In exposed fish, the reduction in oxygen uptake can be correlated to the extent of damage of gill epithelium, throughout the experimental period, the fish showed severe respiratory distress and rapid opercular movements leading to the higher amount of toxicant uptake, increased mucus secretion, higher ventilation volume and decrease in oxygen uptake efficiency, labored breathing and engulfing of air through the mouth fish Labeo rohita observed exposed to Ethion 50% EC.

The increased oxygen consumption at initial stages of exposure i.e. 6 h This present study is in agreement with[16] dimethoate and carbaryl in which an elevation in oxygen uptake is observed during initial stages of exposure i.e., 1-4 hours followed by decrease in subsequent hours. Oxygen consumption was first stimulated and then inhibited in Labeo rohita exposed to lethal and sublethal concentrations of Ethion 50% EC.

The amount of oxygen consumed in mg/g body weight/hrs of the fish *Labeo rohita* exposed to sub-lethal and lethal concentration of Ethion 50%EC:

Hours	Control	50%ECSub-lethal	% Change	50% EC Lethal	% Change
0	0.892 ±0.006	0.880 ±0.006	1.34	0.874 ±0.005	2.01
2	0.846 ±0.004	0.952 ±0.003	12.52	0.818 ±0.006	3.30
4	0.793 ±0.004	1.118 ±0.006	40.98	0.752 ±0.006	5.17
6	0.778 ±0.006	1.360 ±0.003	74.80	0.712 ±0.005	8.48
8	0.769 ±0.005	0.742 ±0.005	4.56	0.654 ±0.005	14.95
10	0.736 ±0.006	0.698 ±0.004	5.16	0.618 ±0.005	16.03
12	0.729 ±0.003	0.682 ±0.007	6.44	0.595 ±0.003	18.38
14	0.715 ±0.004	0.623 ±0.003	12.86	0.570 ±0.003	20.27
16	0.708 ±0.004	0.547 ±0.003	22.74	0.535 ±0.004	24.43
18	0.789 ±0.003	0.538 ±0.006	31.28	0.496 ±0.003	36.65
20	0.692 ±0.003	0.450 ±0.003	34.97	0.390 ±0.005	43.64
22	0.687 ±0.003	0.415 ±0.004	39.59	0.324 ±0.004	52.83

Values are the mean of five observations: Standard Deviation is indicated as (±)., ***Value are significant at $p < 0.05$***

Gills are the major respiratory organs and all metabolic pathways depend upon the efficiency of the gills for their energy supply and damage to these vital organs causes a chain of destructive events, which ultimately lead to respiratory distress[13]. Pronounced secretion of mucus layer over the gill lamellae has been observed during pesticide stress. Secretion of mucus over the gill curtails the diffusion of oxygen[17], which may ultimately reduce the oxygen uptake by the animal. In the present study, the reduction in oxygen uptake can be correlated to the extent of damage of gill epithelium[18].

The metabolic rate (in relation to respiration) of fish could be increased under chemical stress. [15]the dimethoate is efficiently absorbed across the gill and diffused into the blood stream resulting toxic stress to fish. Similar trend was reported in Channa punctatus[19]. Labeo rohita exposed to permethrin[16]. Similarly earlier works revealed a significant reduction in oxygen consumption by many fish species under the toxic stress of aquatic pollutants such as insecticides[5,20].

Oxygen consumption of aquatic animals is a very sensitive physiological process and therefore, alteration in the respiratory activity is considered as an indicator of stress of animals exposed to pesticides. The significant drop in the rate of oxygen consumption was observed in the present study. That gill architecture was severely affected in the fish Labeo rohita exposed to pesticide. The respiratory metabolism was impaired and damage in the gills of fish exposed to the pesticides[16] . An initial increase in oxygen consumption in sublethal and lethal concentrations followed by a decline in subsequent hours and lethal dosed fish[21]. The decreased rate of oxygen consumption with the increase in the test concentrations of pesticide also consequently decreased metabolic rate.

[21]Observed enhancement in the oxygen consumption rate initially in the fishes of sub-lethal and median lethal exposures to endosulfan might be due to a sudden response of the fish to the impending toxicity of endosulfan However, the declining respiratory rates recorded in the subsequent periods in sub-lethal and median lethal exposures suggest that the fish could not succeed in their attempts of boosting oxidative metabolism. The analysis of data from the present investigation indicates a considerable effect of Ethion 50% EC. The present study revealed alterations in the oxygen consumption of Labeo rohita exposed to sublethal and lethal concentrations probably due to impaired oxidative metabolism and pesticide induced stress.

The rate of oxygen consumption is influenced by several factors such as activity, temperature, body size and stage in life cycle, season, time of the day and genetic background [23,22]. Since most fish breathe water in which they live, changes in the chemical properties might reflected in the animal's ventilator activity, particularly the environment affects respiratory gas exchange. Oxygen consumption is an important parameter to assess the toxicological stress, since it serves as index of energy expanded and speaks of physiological and metabolic state of an organism. Generally toxicants gain entry through food chain or respiratory surfaces, the physiological function affected on oxygen consumption.

The metabolic rate has been measured by determining the oxygen consumption, which provides information on the ability of the fish to extract oxygen from pesticide polluted water. An early symptom of acute pesticide toxicity is respiratory distress[17,24]. Respiratory rate has been recognized as an important indicator of stress in organisms exposed to toxic substances. Toxicants from the environment mainly enter fish by means of their respiratory systems[25]. A mechanism of toxicant uptake through gills probably occurs by simple diffusion through pores and is then absorbed through cell membranes.

Oxygen consumption in lethal and sub lethal concentration indicate the sequence type of compensatory mechanism, which operates within the animal to overcome the load of toxic stress. In the present study the variation in oxygen consumption is an indicator of stress, which frequently used to evaluate the changes in metabolism under environmental deterioration. It is evident from the studies that the Ethion 50% EC fresh water fish L. rohita affected. Oxygen consumption of L. rohita under lethal and sublethal concentrations of pesticide to compared with control. Since most fish breathe in the water in which they live, changes in the chemical properties in it might be reflected in the animal's ventilator activity;

particularly the environment factors affect respiratory gas exchange[26]. The fluctuated response in respiration might attribute to respiratory distress because of the impairment of oxidative metabolism. Disturbance in the oxidative metabolism under cypermethrin toxicity in Cyprinus carpio[25].

Oxygen is essential for many metabolic processes that are vital to aerobic life. This dependence on oxygen, forces aerobic life to with stand considerable toxicity[27]. The oxygen paradox derives from the chemical nature of oxygen, which in its atomic form (0) is a free radical and in its molecular form (O_2) is a free bi-radical[28]. [29] Which have speculated that during oxidative stress, catalase activity decreases, hydrogen peroxide accumulates and thereby more peroxidation of lipids is favored. Contaminated water may contain a wide range of organic and metallic pollutants, including polynuclear aromatic hydrocarbons, organochlorine pesticides (DOT, dieldrin), polychlorinated dibenzo-p-dioxins, dibenzofurans and other heterocyclic, organophosphate fertilizers, estrogenic compounds and many metals. Most of these are powerful oxidants[30].

Conclusion

Oxygen consumption in lethal and sub lethal concentration indicate the sequence type of compensatory mechanism, which operates within the animal to overcome the load of toxic stress. In the present study the variation in oxygen consumption is an indicator of stress, which frequently used to evaluate the changes in metabolism under environmental deterioration. It is evident from the studies that the Ethion 50% EC fresh water fish *L. rohita* affected.

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Ethical Clearance: In the present study says that the Ethion (50% EC) is effect the aquatic life.

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