Impact of Organophosphate Pesticide on Oxygen Consumption of The Freshwater Bivalve, Lamellidens marginalis (Lamarck)

KEYWORDS: Lamellidens marginalis, Organophosphate, Acute and Chronic toxicity, Triazophos.

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ABSTRACT *Impact of Acute and Chronic toxicity on oxygen consumption of freshwater bivalve, Lamellidens marginalis was studied. The bivalves were exposed to Acute and Chronic doses of organophosphate pesticide, Triazophos (40% EC). The rate of oxygen consumption for acute treatment was recorded after 24, 48, 72 and 96 hrs. While for chronic treatment, was recorded for 7, 14 and 21 days. The observations indicate that the rate of oxygen consumption was found to be decreased with increase in exposure period.*

Introduction

Respiration is one of the most important characteristics of life. It provides energy to perform various activities of body like movement, metabolic reactions, growth and development, muscular contraction, reproduction etc. A steady supply of oxygen is essential for the maintenance of life. The supplied oxygen oxidizes food materials to release the energy that in turn powers various life processes.

The activity of animal can be measured in terms of oxygen uptake. Aquatic animals have to pass large quantities of water over their respiratory surface and are subjected to relatively greater risk of exposure to the toxic substance (Shelke and Wani, 2005).

Environmental pollution is one of the undesirable side effect of industrialization and an important aspect of environmental degradation (Jothinarendiran, 2012). Pesticides when released into aquatic environment are sustained in water as a part of the environment. Majority of the pesticides have tendency to accumulate in tissues of aquatic animals. The excess pesticides in the environment cause damage to the behaviour and physiology of living organisms especially the respiratory physiology. The assessment of these effects of insecticides to non-target aquatic organisms is very difficult. As a result of the pollutants from industrial areas and agricultural runoff into the environment pollute water bodies (Tyagi et al., 2000) and their chemical persistence; many freshwater ecosystems are facing the spatial or temporal alarming high levels of xenobiotic chemicals (Brack et al., 2002). Considerable attention has been paid towards crustacean and molluscan animals chiefly because of their important role on aquatic food chain.

Depletion in oxygen content occurs in the medium when pesticides, chemicals, sewage and other effluents containing organic matter are discharged into the water bodies. In the aquatic environment, one of the most important manifestation of the toxic action of chemical is the over stimulation or depression of respiratory activity. Aquatic organisms like prawns, fish, bivalve, crab respire through gills. Such respiratory surfaces may lead to the alteration in the normal respiratory area which causes reduction in oxygen consumption and physiological imbalance in the organism (Mukke and Chinte, 2012).

Respiration also plays an important role in studying aquatic toxicology. To the action of pollutant initial response given by an organism on oxygen uptake, which reflects bioenergetical process and metabolism is a good analyzer of the physiological state of an organisms. The most important part of this aspect is the reduced oxygen consumption which would create physiological imbalance to the organism (Singh and Singh, 1979). Heavy metal pollution and pesticides cause alterations in the oxygen consumption in freshwater animals (Pawar and Katdare, 1984). Shaikh et al. (2010) studied the effect of mercuric and cadmium chloride on oxygen consumption of freshwater crab, Barytelphusa cunicularis.

Materials and Methods

The fresh water bivalves, Lamellidens marginalis were collected from Hatnur dam near Hatnur. The animals were immediately brought to laboratory and acclimatized for 4-5 days at laboratory conditions. Medium sized healthy and active bivalves were used for experiments. They were divided into three groups, first group was considered as control, animals of second group were exposed to acute concentration (3.67 ppm, LC50/2 values of 96 hours) of triazophos up to 96 hours and of third group to chronic concentration (0.734 ppm, LC50/10 values of 96 hours) of triazophos up to 21 days. The rate of oxygen consumption of control animals and animals exposed to acute concentrations was estimated after every 24 hours up to 96 hours and that of animal exposed to chronic dose was estimated after every 7 days with control up to 21 days. Oxygen consumption was estimated by standard Winkler's method (Welsh and Smith, 1960). The animals were dissected and the fresh weight of soft body was measured. Oxygen consumption was expressed as ml of oxygen consumed per gram of soft body wet weight per hour per litre (ml of oxygen consumed/gm of soft body wet weight/hr/lit at NTP). The `t' test was carried out and percent change in oxygen consumption in exposed animals was noted.

Results

The measurement of rate of oxygen consumption in Lamellidens marginalis after acute and chronic exposure to Triazophos showed significant decrease in the rate of oxygen consumption as observed in Table 1 and 2. The rate of oxygen uptake of L. marginalis after acute exposure was significantly decreased after every 24 hours up to 96 hours as compared to those of control group of bivalves. Table 1 indicates that L. marginalis showed gradual decrease in the rate of oxygen consumption on acute treatment to triazophos.

The treatment of LC50/10 concentrations of triazophos showed a profound decrease in the rate of oxygen consumption after every 7 days in experimental bivalves as compared to the control group. The decrease depicted after 21 days was more than that of the bivalves exposed to acute dose.

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Table 1: Rate of Oxygen consumption of L. marginalis on acute exposure to triazophos.

Sr. No.	Treatment	Average Oxygen consumption (ml/gm./lit/hr.)			
		24 hrs.	48 hrs.	72 hrs.	96 hrs.
1	Control	0.4966±0.030	0.4912±0.032	0.4905±0.031	0.4901±0.034
2	Triazophos (3.67ppm)	0.4785±0.029* (-3.65)	0.4656±0.031** (-5.21)	0.4430±0.030** (-9.68)	0.4309±0.032** (-12.08)

Table 2: Rate of oxygen consumption of L. marginalis on chronic exposure to triazophos.

Sr. No.	Treatment	Average Oxygen consumption (ml/gm./lit/hr.)		
		7 days	14 days	21 days
1	Control	0.3161±0.030	0.3137±0.038	0.3081±0.045
2	Triazophos (0.734 ppm)	0.2599±0.023*(-17.78)	0.2563±0.025NS (-18.30)	0.2516±0.021NS (-18.34)

Each value represents a mean of three observations ± standard deviation;

Values in ( ) indicates percent variation over the respective control;

Values are significant at * = P <0.05; ** = P <0.01 and NS = Non-significant.

Figure I: Rate of Oxygen consumption of L. marginalis on acute exposure to triazophos.

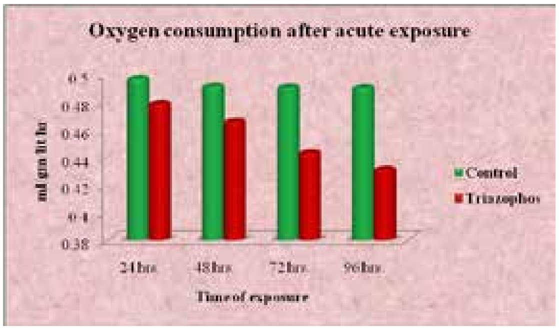
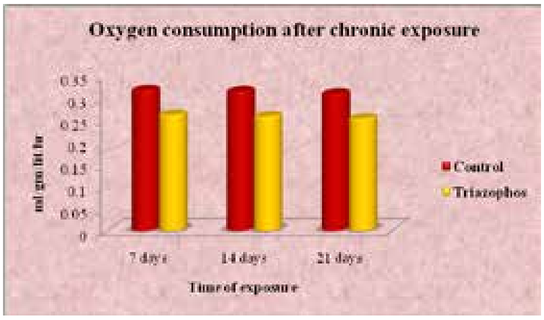


Figure II: Rate of Oxygen consumption of L. marginalis on chronic exposure to triazophos.



Discussion

Pesticides affect the metabolism of the freshwater bivalves Lamellidens marginalis. Alteration in metabolic processes following exposure to pesticidal stress has always been used as indicator of stress. But there is a vast difference in the pattern of pesticide induced physiological alterations from pesticide to pesticide and animal to animal. The alteration in the normal respiratory metabolism is due to its intimate contact with polluted water which decreases the oxygen diffusing capacity of the gills (Jadhav et al., 2011).

Senthilmurgan et al. (1994) reported that declined rate of oxygen consumption was indirectly affected by decreased cardiac activity due to pesticide stress. This might have happened in case of Lamellidens marginalis after exposure to pesticides and resulted into sharp decrease in oxygen consumption, which continued with the time of exposure.

Pollutants of any nature are known to impair the blood transport efficiency of animal which result in respiratory alterations (Kulkarni and Kamath, 1980). Mukke and Chinte, (2012) observed decrease in oxygen level with increase in concentration.

In present investigation, the rate of oxygen consumption changes after treatment of pesticides. In acute treatment of triazophos to bivalve Lamellidens marginalis, the rate of oxygen consumption decreased. The decrease in oxygen consumption in the bivalve after exposure to triazophos might be due to reduced gill respiration. The decline was greater in higher concentration which might be the result of reduced rate of metabolism owing to toxicant stress. Respiratory inefficiency and total respiratory breakdown can also be due to the formation of mucus on the respiratory organs.

In present investigation, mucus may be secreted to cope with pesticidal stress, mucus acts as diffusion barrier contributing to the hypoxia and affected the respiration, resulting in the decrease in oxygen consumption rate. Respiratory inefficiency and ultimately total respiration breakdown in molluscs can also be due to the formation of mucus on the respiratory organ to reduce exposure to environmental stress or pollutant (Alam and Lomte, 1984; Sontakke, 1992).

Kamble and Shinde (2012) observed decrease in oxygen consumption in bivalve, Lamellidens corrianus exposed to organochlorine pesticide. Mane et al. (2012) recorded decrease in the rate of oxygen consumption in freshwater bivalve, Lamellidens corrianus after exposure to thiodan. Kumar et al. (2012) observed decrease in oxygen consumption of freshwater mussel, Lamellidens marginalis after exposure to dimethoate.

In present study the freshwater bivalve, Lamellidens marginalis showed decreased rate of oxygen consumption in acute as well as in chronic treatment of the pesticide triazophos as compared to control. The copious mucus secretion was observed in pesticide exposed bivalves which might have caused decreased level of oxygen consumption.

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