ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Impact of Organochlorine Pesticide on Oxygen Consumption in the Freshwater Bivalve Mollusc Lamellidens Corrianus.

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ABSTRACT

Impact of acute toxicity on oxygen consumption of freshwater lamellibranch mollusc, Lamellidens corrianus was studied during three seasons namely monsoon, winter and summer. The molluscs were subjected to acute treatment of organochlorine pesticide Thiodan (Endosulfan 35% EC) for 96 hr. the rate of oxygen consumption was recorded after 0, 24, 48, 72 and 96 hr. The observations indicate that the rate of oxygen consumption was found to be decreased during all three seasons when compared to Thiodan (Endosulfan 35 % EC).

Keywords: Lamellidens corrianus, Organochlorine, Acute toxicity, Thiodan, Endosulfan

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ISSN: 0975-8585

INTRODUCTION

Respiration is an important phenomenon of the life and rate of oxygen consumption reflect the internal metabolic activities of the animals. In aquatic animals, the respiration plays a major role in controlling the energy transformation in the animals. Therefore, the metabolic responses of organisms due to the changes in the surrounding environment are an indicator of the adjustment capacity of the organism. Increase in human population and there after effects, induce environmental pollution results in the depletion of available oxygen from aquatic media. The agricultural, industrial and domestic effluents degrade overall aquatic biota. Environmental pollution from pesticides is an important issue that attract wide spread public concern. Among them, some organophosphate and organochlorine pesticides are routinely used in agriculture [1] .

The agricultural, industrial and domestic effluents degrade overall aquatic biota. Respiration is an important phenomenon of the life and rate of oxygen consumption reflect the internal metabolic activities of the animals. In aquatic animals, the respiration plays a major role in controlling the energy transformation in the animals. Therefore, the metabolic responses of organisms due to the changes in the surrounding environment are an indicator of the adjustment capacity of the organism. Increase in human population and there after effects, induce environmental pollution results in the depletion of available oxygen from aquatic media. Holden stated that, respiration and pesticide intake via gill will be rapid in aquatic animal at high temperature, this is because oxygen demand being increased during reduction in solubility [4] many exhaustive and compressive study have been carried out [5,6,7,8] . Nasir Shaikh and Yeragi [10] have studied the effect of various concentration of Endosulfan and fenvalrate of respiratory metabolism of Lepidocephalechtyes thermalis by using different concentration. Respiration is vital process through which the organisms obtained and utilize it for energy production during oxidative metabolism [12,13]. Aquatic animals have to pass large quantities of water over their respiratory surface and are subjected to relatively great risk of exposure to the toxic substances [16]. Considering this point of view present study was undertaken to find out the impact of Thiodan (Endosulfan 35 % EC) on oxygen consumption in freshwater bivalve mollusc, Lamellidens corrianus.

MATERIALS AND METHOD

The experiment for oxygen consumption were performed in a specially designed respiratory glass jar of one liter capacity fitted with rubber cork having inlet and outlet connected with rubber tube. Each bivalve from individual group was marked on the shell. The marked bivalve molluscs were weighted by using digital single pan balance and kept one in each jar and the tap water was allowed to flow for 2-3 min through inlet and immediately the tube was pinched tightly without leaving air bubble. Soon after opening the valve the time was counted till one hr. After one hour, from each respiratory jar the water was carefully siphoned out in stopper reagent bottle and oxygen was estimated.

For the determination of oxygen consumption the bivalve mollusc from control, LC10 and LC50 groups of pesticide acute toxicity experiments individually marked species were used for each season. The marked individuals were separately used throughout experimental period for determination of oxygen consumption. The rate of oxygen consumption of bivalve mollusc, Lamellidens corrianus from control, LC10 and LC50 groups for both the pesticides toxicity experiments was determined at 24 hr interval starting from 0 hr to period of 96 hr. The rate of oxygen consumption was determined by modified method of Winker's method (Welsh and Smith) [24].

All the values were subjected to statistical analysis for confirmation. The difference of oxygen content of the water prior to the experiment and after one hour was taken as mg of oxygen consumed/l/hr/gm body weight of bivalve mollusc, Lamellidnes corrianus. Comparing the results with control, the changes in the rate of oxygen consumption from LC10 and LC50 group were statistically analyzed and were calculated for each pesticide. By using student 't' test[3] The experiments were repeated for three times for confirmation for each season.

RESULT AND DISCUSSION

Table 1: The rate of oxygen consumption in freshwater bivalve mollusc, Lamellidens corrianus after acute exposure to Thiodan (Endosulfan 35 % EC), during monsoon.

No.	Treatment	Average O2 consumption mg/l/h/gm dry wt				
		0hr	24hr	48 hr	72hr	96 hr
1	Control	0.140±0.003	0.143±0.004	0.141±0.005	0.144±0.005	0.138±0.004
2	LC_{10}	0.138± 0.002	0.088***±0.004 (38.46%)	0.067***±0.006 (52.48)	0.056***±0.005 (66.66)	0.046***±0.004 (73.91)
3	LC_{50}	0.137±0.003	0.072***±0.002 (49.65)	0.054***±0.004 (60.99%)	0.048***0.005 (73.61%)	0.039***0.004 (74.18%)

Values are significant at * P<0.05 ** P<0.001 *** P<0.001

Table 2: The rate of oxygen consumption in freshwater bivalve mollusc, Lamellidens corrianus after acute exposure to Thiodan (Endosulfan 35 % EC), during winter.

No.	Treatment	Average O2 consumption mg/l/h/gm dry wt				
		0hr	24hr	48 hr	72hr	96 hr
1	Control	0.130±0.002	0.128±0.004	0.127±0.005	0.123±0.004	0.122±0.006
2	LC_{10}	0.128±0.002	0.089●±0.004	0.074***±0.003 (41.73%)	0.042***±0.004 (42.27%)	0.052***±0.004 (44.26%)
3	LC_{50}	0.127±0.002	0.073***±0.004 (42.96%)	0.068***±0.005 (46.45%)	0.058***0.004 (52.84%)	0.052***0.004 (57.37%)

Values are significant at * P<0.05 ** P<0.001 *** P<0.001

Table 3: The rate of oxygen consumption in freshwater bivalve mollusc, Lamellidens corrianus after acute exposure to Thiodan (Endosulfan 35 % EC), during summer.

No.	Treatment	Average O2 consumption mg/l/h/gm dry wt				
		0hr	24hr	48 hr	72hr	96 hr
1	**Control**	0.123±0.004	0.110±0.005	0.107±0.004	0.105±0.006	0.108±0.006
2	**LC_{10}**	0.121±0.003	0.072***±0.004 (20.00%)	0.081●±0.004 (24.29%)	0.086***±0.004 (35.23%)	0.066***±0.002 (38.88%)
3	**LC_{50}**	0.118±0.004	0.067***±0.005 (39.09%)	0.058***±0.005 (45.79%)	0.052***±0.004 (50.47%)	0.047***±0.003 (56.48%)

Values are significant at * P<0.05 ** P<0.001 *** P<0.001 ●- Non-significant

Rate of oxygen consumption during monsoon season (Table No. 1) was compared with control values after 24 hr of exposure in LC_{10} concentration of Thiodan (Endosulfan 35 %EC) there was significant decrease in the rate was 38.46 % (P<0.001). Similarly, after 48, 72, and 96 hr of exposure to LC_{10} concentration the rate of oxygen consumption decreased to 52.48 % (P<0.001), 66.66 % (P<0.001) and 73.91 % (P<0.001), respectively. Similarly, when compared with control values after 24 hr of exposure to LC_{50} concentration, there was significant decrease in the rate of oxygen consumption it was 49.65 % (P<0.001), 60.99 % (P<0.001). 73.61 % (P<0.001) and 74.63 % (P<0.001) for 24, 48, 72 and 96 hr respectively. When compared with LC_{10} and LC_{50} concentration exposures after 24 hr, 48 hr, 72 hr and 96 hr the rate was significantly decreased to 18.18 % (P<0.01), 17.91% (P<0.01), 20.83 % (NS; 0.848), 2.77 % (NS; 0.6738), respectively.

During winter, (Table No.2) rate of oxygen was compared with control values after 24 hr of exposure in LC_{10} concentration of Thiodan, (Endosulfan 35 %EC) there was non-significant decrease in the rate of oxygen consumption which was 30.46 % (NS). After 48,72 and 96 hr of exposure it was 41.73 % (P<0.001), 42.27 % (P<0.001) and 44.26 % (P<0.001). respectively. when rate of oxygen consumption was compared with control values after 24,48,72 and 96 hr of exposure to LC_{50} concentration, there was significant decrease in the rate and it was 42.96 % (P<0.001), 46.45 % (P<0.01), 52.84 % (P<0.001), 57.37 % (P<0.001), respectively. When the rate of oxygen consumption was compared with LC_{10} and LC_{50} concentration exposure after 24, 48, 72 and 96 hr the rate was significantly decreased to 17.97 % (P<0.05), 8.10 %(NS), 18.31 %(P<0.05) , 23.52 % (P<0.05), respectively.

During summer (Table No.3) after 24 hr of exposure in LC_{10} concentration of Thiodan (Endosulfan 35 %EC) there was significant decrease in the rate of oxygen consumption which was 20.00 % (P<0.001). After 48 hr of the oxygen consumption was non-significantly decreased to 24.29 % (NS). After 72 hr oxygen consumption decreased more significantly to 35.23 % (P<0.001), and at 96 hr of the rate of decreased to 38.88 % (P<0.01). Similarly, after 24 hr, 48 hr, 72 hr and 96 hr of exposure to LC_{50} concentration there was significant decrease in the rate of oxygen consumption which was 39.09 % (P<0.001), 45.79 % (P<0.001), 50.47 % (P<0.001) and after 96 hr of exposure the rate was decreased to 56.48 % (P<0.001). When compared with LC_{10} and LC_{50} concentration exposure after 24 hr, the rate was significantly decreased to 6.94 %

(NS), after 48 hr it decreased significantly to 28.39 % ($P<0.05$), after 72 and 96 hr the rate of oxygen consumption decreased significantly to 23.52 %($P<0.05$) ,28.78 % ($P<0.05$), respectively.

Study conducted by Muley and Mane [11] observed that the rate of oxygen consumption from freshwater gastropod, Viviparous bengalensis (Lamarck) after treatment of Falithion and Lebaycid during all the three seasons. They stated that, the decrease in oxygen consumption was comparatively more in LC_{50} concentration than in LC_0 during monsoon and winter than in summer. This was more severing in Lebaycid exposed snails than in Falithion. They concluded that, the gastropods exposed to different concentrations did not accept new state of metabolism to adjust the continual insecticidal stress. Pawar and Katdare [15] studied the effect of sublethal concentration of Zinc on oxygen consumption of the freshwater fish, Nemachelus botia and Gambusia affinis and observed reduction in oxygen consumption from experimental groups of both the fishes.

Rao et al while studying impact of Endosulfan and cythion-malathion on respiration of gastropod, Thiara lineata observed reduction in oxygen consumption from experimental group and stated that, the decreases were due to changed metabolic activity, accumulation of pesticide and damage to internal cellular architecture. They further concluded that Endosulfan is more hazardous than Cythion and Malathion to snail Thiara lineata. Reduction in oxygen consumption due to carbaryl in fish, Channa punctatus was observed [2]. Patil et al [14] while studying the effect of organophosphate pesticides Zolon and Rogor on respiration of the freshwater gastropod, Thiara lineata and reported significant decreases in rate of respiration from LC_{10} and LC_{50} groups. It was more pronounced in Rogor compared with Zolon and the severity was more in LC_{50} group than Lc_{10} group. Indonaia Caeruleus. Similar reports were available to show the depletion of oxygen in fish, snails and muscles due to pesticide toxicity stress [16,17,18,20,22]. Sultana and Lomte [23] while studying the effect of copper sulphate on oxygen consumption observed reduction from Lamellidens marginalis. Shelke and Wani [19] while studying respiratory responses of fresh water fish, Amblypharyngodon mola due to mercuric chloride, and arsenic chloride on oxygen consumption found decreasing rate with increase in exposure period. They have concluded that the decrease in respiratory metabolism was due to the gill damage, formation of mucous film over the gill and reduction in efficiency of oxygen up take of the animal. Similar might be the case for present investigation in which reduction in oxygen consumption was more pronounced in the experimental groups from all the seasons due to acute toxicity.

Muley and Mane [12] while studying the toxicity of malathion on oxygen consumption in bivalve Lamellidens marginalis and Lamellidens corrianus, during three different seasons and observed variation in oxygen consumption from both animals and both the experimental groups and stated that both the species of bivalve from LC_{50} group showed similar sequential of changes in oxygen consumption during three different seasons. They concluded that, the decrease in oxygen consumption was more in Lamellidens marginalis in summer than in monsoon and winter. They further conclude that, the decrement in oxygen consumption was due to the lethal effect on gills architecture at higher concentration.

CONCLUSION

In the present study, from all the three different seasons, in the freshwater lamellibranch mollusc, Lamellidens corrianus due to pesticidal stress of Thiodan (Endosulfan 35 % EC) revealed variation in rate of oxygen consumption, significantly in LC_{10} and LC_{50} groups. The rate was particularly decreased in the summer season followed by monsoon and winter. It can be stated that, penetration of pesticides in to the body of bivalves might have affected the gill architecture and could have alter the rate of oxygen consumption. It is also further stated that, due to pesticidal toxicity Lamellidens corrianus did not adjust themselves with new state of metabolism to counteract to the continued pesticidal stress.

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