Nature Environment and Pollution Technology
An International Quarterly Scientific Journal

Vol. 8	No. 3	pp. 529-532	2009

Original Research Paper

Pollutional Effect of a Pesticide Bayrusil on Bimodal Oxygen Consumption in an Air Breathing Fish, *Heteropneustes fossilis* (Bloch.)

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Key Words:
Pollutional effect
Pesticide
Bayrusil
Oxygen consumption
Heteropneustes fossilis

ABSTRACT

In the present investigation an attempt has been made to assess bimodal oxygen consumption in an air-breathing fish, *Heteropneustes fossilis* (Bloch.) under bayrusil (Quinalphos) exposure. The treatment of the fish with bayrusil brought significant decrease in total oxygen uptake as compared to the control but oxygen consumption through aerial route increased significantly in bayrusil treated fish. The increased dependency on aerial respiration might be due to avoidance of fish with the aquatic medium containing the toxicant.

INTRODUCTION

Aquatic biota are known to be highly sensitive to the physico-chemical changes of their habitat, particularly in the confined water areas of pools, paddy-fields, ponds and tanks. With the introduction of scientific methods of farming, there has been excessive use of simple and complex types of insecticides, pesticides, herbicides, and fertilizers with the sole aim of getting more crop-yields from the fields. However, these agrochemicals reach the water sources directly in case of paddy-fields with the accumulated water therein, or are swept through the rain water or irrigated surplus water to nearby enclosed water areas where fishes live together with the primary producers and consumers of all kinds and have, as such, chance of getting agricultural toxicants which adversely cause survival, behavioural, physiological, biochemical and respiratory problems in them.

Respiration is one of the most important physiological parameters on which many vital functions of fishes depend (Mulla Reddy 1987). This, in turn, has a direct bearing on productivity of the ecosystems in terms of fish production per unit area. Several authors have studied the effects of pesticides and other chemicals on oxygen consumption of fishes (Arunachalam et al. 1980, Lunn et al. 1976, Vasanthi 1985, Vasanthi & Ramaswamy 1987, Govindraj 1992, Kumar et al. 1998, Santhakumar & Balaji 2000, Rajamannar & Manohar 2000, Remia et al. 2008), but much less work has been carried out on the effects of pesticides on bimodal respiration in air-breathing fishes.

In the present investigation, an attempt has been made to study the effects of an agrochemical, Bayrusil on bimodal oxygen uptake in an air-breathing fish, *Heteropneustes fossilis* (Bloch.).

MATERIALS AND METHODS

Healthy and adult specimens of *Heteropneustes fossilis* (50.0 ± 1.30 g) were collected locally and kept in a large aquarium in the laboratory with goat liver as their diet. They were allowed acclimatization to the laboratory conditions for at least 10 days.

The acclimatized fish were divided in to four groups; group-I served as control, whereas group-II, III and IV were treated with 1/5th, 1/10th and 1/15th of predetermined LC50/96 hr concentration of the pesticide bayrusil, and rate of oxygen consumption was measured at 96 hours. For determination of bimodal oxygen consumption in *H. fossilis,* the methods of Ojha et al. (1979) were employed. In this method a closed glass respirometer containing 3-L water and 0.51 mL air was used. The fish had a free access to the air through a semicircular hole of about 10.0 cm diameter in a disc float of a thermocol material which separates the water/air interface of respirometer. Carbosorb (KOH solution) in a Petri dish was placed on the float which absorbed CO_2. The air phase of the respirometer was connected with a differential manometer. The concentration of dissolved O_2 content in the water was measured by Winkler's volumetric method (Welch 1948).

RESULTS AND DISCUSSION

The results showing aquatic, aerial and total oxygen uptake in control and bayrusil treated *H. fossilis* are presented in Table 1. Under normal condition (control) the fish consumes about 70.29 % oxygen from aquatic route, and 29.71 % from aerial route. On exposure to different concentrations of bayrusil, the fish consumes a lowest of 14.29 % oxygen from aquatic route and a lowest of 68.75 % oxygen from aerial route. The total O_2 consumption in the control was 50.5 mL/g/hr but in bayrusil treated fish it decreased to a significant level (14.29-31.25 mL/g/hr) as compared to the control, showing that the pesticide has its toxic effect on respiratory efficiency of the fish.

Oxygen intake by an organism is an important physiological phenomenon and the quantum of O_2 intake determines the physiological status and metabolic activity of the animal. It not only indicates the metabolic rate but also provides an index of stress condition. The intimate contact of gills with the polluted water leads to changes in normal respiratory mechanism, lowering the diffusion of oxygen through gills causing reduced oxygen consumption, which create physiological imbalance in organisms. Uthamal (1977) in *Colisa lalia,* and Govindraj (1992) and Vasanthi & Ramaswamy (1987) in *Sarotherodon mossambicus* reported a significant decrease in O_2 consumption after treatment of different pesticides in the fish species while Mulla Reddy (1987) in *C. carpio,* Pandey et al. (1999) in *C. batrachus,* Jobde & Ansari (1993) in *Neomecheilus aureus* and Karuppiah (1996) in *C. striatus* reported elevated O_2 uptake after treatment with different pesticides. Rapid rate of oxygen consumption in *Anabas scandens* after exposure to sumithion was reported by Natarajan (1980). Rao et al. (1980) showed that in case of *Labeo rohita* O_2 consumption increased up to certain level and decreased with further increase of toxicant until death. Among others who worked on O_2 consumption in fishes under toxic condition, mention may be made of Rafia & Uma (1995), Saxena & Chauhan (1996), Borah (1996, 2005), Throat & Wagh (2001) Mathivanan (2004) and Remia et al. (2008).

The results of the present study reveal that the agrochemical bayrusil has its adverse effect on the

Table 1: Effect of Bayrusil on bimodal oxygen consumption in *Heteropneustes fossilis.* (Body wt., 50.0 ± 1.30 g; Temperature, 22°C, N = 6)

S. No.	Condition	Dose of the pesticide (ppm)	Oxygen consumption (mL/g/hr)			% of O_2 consumed	
			Aquatic	Aerial	Total	Aquatic	Aerial
1.	Control	-	35.5	15.0	50.5	70.29	29.71
2.	Bayrusil	3	7.5	16.5	24.0	31.25	68.75
3.	Bayrusil	4	5.0	17.0	22.0	22.72	77.28
4.	Bayrusil	8	3.0	18.0	21.0	14.29	85.71

respiratory metabolism in *H. fossilis* which could be due to accumulation of different toxic elements of the pesticide in the gill filaments. The toxic ingredients of the pesticide might have interfered with respiration of fish as it causes gill damage, alteration in branchial filament, loss of acidophiles, and loss of mucous cells (resulting in epithelial sloughing) resulting in overall decrease of O_2 consumption. Injury to R.B.C., reduction in haemoglobin content and changes in haemoglobin-oxygen binding capacity might be the reason for drop in O_2 uptake in fishes exposed to various toxins.

In case of bimodal respiration (aquatic and aerial) in fishes in waterborne toxins, it seems that air-breathing increases the resistance of fish by permitting a decreased ventilation in order to avoid the absorption of the toxins. During stress condition, the fish decrease its gill ventilation rate for trapping less oxygen from water. The pollutants may pass into the body through gill, bucco-pharyngeal membrane or skin and in exchange, water of the body may diffuse out.

Owing to steady inflow of pollutant molecules and outflow of body water, the fish may become osmotically stressed and need more energy to eliminate these undesirable molecules. Due to increase in demand of energy, the fish restored to air-breathing and minimizing the inflow of pollutant molecules by lowering gill ventilation rate (aquatic respiration).

ACKNOWLEDGEMENT

The authors are grateful to Prof. M. Raziuddin, Head, Deptt. of Zoology, Vinoba Bhave University, Hazaribagh, Jharkhand for his co-operation and suggestion.

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