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Original Research Paper

Effect of Two Organophosphorus Insecticides on Respiratory Activities of the Fish *Labeo rohita*

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ABSTRACT

Effects of two organophosphorus insecticides, Dimethoate (30% EC) and Quinalphos on oxygen consumption of a freshwater fish *Labeo rohita* were investigated under lethal and sublethal toxicity in the present study. Median lethal concentration (LC_{50}) value of Dimethoate (30% EC) and Quinalphos of the fish were determined during bioassay study. The rate of oxygen consumption of the fish was studied under lethal and sublethal concentration of Dimethoate (30% EC) and Quinalphos at 1, 2, 3 and 4 hours intervals. It showed significantly decreased oxygen uptake. The experimental results depict that the organophosphorus pesticides Dimethoate (30% EC) and Quinalphos are toxic to the fish *Labeo rohita* and the stress response showed by the fish are dependent on concentration of toxicant and time of exposure.

INTRODUCTION

The indiscriminate and widespread use of pesticide and their subsequent passing into aquatic systems question the very survival and the behavioural, physiological and biochemical functioning of aquatic animals, particularly fishes of commercial importance. Any change in the behaviour and physiology of fishes indicate the deterioration of water quality. Some detailed work has been published, which indicate the need for giving a fresh look on the safe disposal of various toxicants into natural waters for the protection of fishes and aquatic ecosystems (Murthy 1986). In aquatic toxicology the traditional LC_{50} test is often performed to measure the potential risk of a chemical (Jach de Brujis et al. 1991). Arockia Rita & John Milton (2006) reported the effect of an organophosphorus pesticide on oxygen consumption and haematology of a freshwater fish *Oreochromis mossambicus*. Studies on oxygen consumption form a useful tool in the assessment of toxicant stress on aquatic organisms and give an index of energy expenditure mechanisms for environmental variation (Sornaraj et al. 2005).

Based on the literature, it is evident that studies on the effects of organophosphorus pesticides on fish and other aquatic organisms are very much needed. Therefore, in the present study an attempt has been made to investigate the effect of two organophosphorus insecticides, Dimethoate (30 % EC) and Quinalphos on the rate of oxygen consumption of the fish *Labeo rohita*.

MATERIALS AND METHODS

Labeo rohita, which is a commonly occurring freshwater major carp fish, available in local ponds and river, was selected for the experimental studies. It is distributed in north and central India, Pakistan, Bangladesh and Burma. It is a bottom feeder and the body is moderately elongated with small mouth and thick lips.

Two organophosphorus insecticides Dimethoate (30%EC) (Rogor) and Quinalphos (Quinaal) were taken for the present study, which are wide spectrum contact and stomach poisonous insecticides with quick knockdown effect. They are systematic poisons and affect the nervous system of insects.

Bulk of sample of fish, *Labeo rohita* ranging in weight from 2 g to 6 g and measuring 4 cm to 7 cm in length were procured from Aliyar reservoir. Fish were acclimatized to the laboratory condition for two weeks. During this period the fish were fed with mixture of oilcake and rice bran.

After acclimation fish of about same size (weight and length) irrespective of sexes were selected for the experiment. Feeding was stopped one day before the commencement of the experiment. Preliminary tests were carried out to find out median lethal concentration (LC_{50}) of Dimethoate (30% EC) and Quinalphos. The concentration at which 50% kill of the fish occurred after 24 hrs treatment was taken as the median lethal concentration (LC_{50}).

The rate of oxygen consumption was carried out in lethal and sublethal concentration of Dimethoate (30%EC) and Quinalphos. The oxygen uptake by the fish was estimated by measuring loss of dissolved oxygen content of water in the respiratory chamber. The dissolved oxygen content of the water samples was estimated by Winkler's method (Welsh & Smith 1953). The oxygen consumption of fish was expressed in mL/g/hr. The data of the results obtained from the studies were analysed statistically.

RESULTS

In the present study, 24 hrs LC_{50} of Dimethoate (30% EC) and Quinalphos for the fish *Labeo rohita* was found to be 34 ppm and 11 ppm respectively. The median lethal concentration was arrived after 6 preliminary toxicity tests for the pesticides. Behavioural changes like erected swimming and rapid opercular movement were noticed during the LC_{50} (24 hours) treatment. There was no behavioural change in the control.

Rate of oxygen consumption in the lethal concentration of Dimethoate (30% EC) was 0.477, 0.377, 0.214 and 0.192 mL/g/hr during the 1, 2, 3 and 4 hrs of exposure respectively. The rate of oxygen consumption in the non-treated fish was 0.737, 0.618, 0.513 and 0.373 mL/g/hr during the 1, 2, 3 and 4 hrs of exposure respectively (Table 1).

The effect on oxygen consumption of the fish *Labeo rohita* exposed to sublethal concentration of Dimethoate 30% EC was 0.706, 0.629, 0.525 and 0.391 mL/g/hr and the treated fish showed the rate of oxygen consumption as 0.434, 0.298, 0.206 and 0.167 mL/g/hr during 1, 2, 3 and 4 hrs of exposure respectively.

In the lethal concentration of Quinalphos, the rate of oxygen consumption was 0.310, 0.225, 0.311 and 0.279 mL/g/hr, while the non-treated fish showed 0.811, 0.624, 0.502 and 0.336 mL/g/hr during 1, 2, 3 and 4 hrs of exposure respectively (Table 2).

The rates of oxygen consumption of the fish exposed to sublethal concentration of Quinalphos was 0.371, 0.324, 0.228 and 0.297 mL/g/hr, while the non-treated fish showed 0.824, 0.741, 0.534 and 0.423 mL/g/hr during 1, 2, 3 and 4 hrs of exposure respectively.

The rate of percent change was higher in acute toxicity of Dimethoate (30% EC) than the acute toxicity of Quinalphos. Similarly, the higher percent change was recorded in sublethal concentration of Dimethoate (30% EC) compared to the sublethal concentration of Quinalphos. The 't' test showed significant changes in both acute and sublethal toxicity of Dimethoate (30% EC) and Quinalphos.

Table 1: Oxygen consumption (mL/g/hr) of the fish ***Labeo rohita*** exposed to varying periods of Dimethoate (30% EC) under acute and sublethal toxicity.

Toxicity introduced	Exposure Periods	Control	Experiment (with pesticide)	Percent change	*t*-test
Acute toxicity	1 hr	0.737 ± 0.033	0.477 ± 0.034	64.79	0.0033
	2 hr	0.618 ± 0.071	0.377 ± 0.063	44.74	0.0424
	3 hr	0.513 ± 0.020	0.214 ± 0.009	41.79	0.0020
	4 hr	0.373 ± 0.053	0.192 ± 0.010	51.52	0.0363
Sublethal toxicity	1 hr	0.706 ± 0.030	0.434 ± 0.056	61.47	0.0031
	2 hr	0.629 ± 0.063	0.298 ± 0.014	47.45	0.0111
	3 hr	0.525 ± 0.086	0.206 ± 0.11	39.27	0.0247
	4 hr	0.391 ± 0.09	0.167 ± 0.015	42.71	0.0418

Values are means of ± SD of five individual observations. Values are significant at 5% level.

Table 2: Oxygen consumption (mL/g/hr) of the fish ***Labeo rohita*** exposed to varying periods of Quinalphos under acute and sublethal toxicity.

Toxicity introduced	Exposure Periods	Control	Experiment (with pesticide)	Percent change	*t*-test
Acute toxicity	1 hr	0.811 ± 0.082	0.310 ± 0.075	38.24	0.0264
	2 hr	0.624 ± 0.046	0.225 ± 0.057	36.11	0.0184
	3 hr	0.502 ± 0.009	0.311 ± 0.103	61.71	0.0768
	4 hr	0.336 ± 0.056	0.279 ± 0.048	83.05	0.2905
Sublethal toxicity	1 hr	0.824 ± 0.074	0.371 ± 0.058	44.98	0.0135
	2 hr	0.741 ± 0.091	0.324 ± 0.55	43.25	0.0174
	3 hr	0.534 ± 0.586	0.228 ± 0.053	42.73	0.0259
	4 hr	0.423 ± 0.044	0.297 ± 0.092	70.13	0.1773

Values are means of ± SD of five individual observations. Values are significant at 5% level.

DISCUSSION

The behavioural changes observed during acute Dimethoate (30% EC) and Quinalphos toxicity tests may be due to toxicant induced stress. The fish showed abnormal behaviour such as erected swimming movement, increased opercular activity, jumping out of the test medium, and loss of equilibrium. Saxena et al. (1997) noticed similar abnormal behavioural pattern in *Channa orientalis* during the exposure of Nuvan and Dimecron. The control group of fish did not exhibit any sort of stress or behavioural changes showing that there was no other injurious substances or condition causing the mortality of fish except the toxic chemicals Dimethoate (30% EC) and Quinalphos in the experimental tubs. Maheswari et al. (2001) have observed the median lethal concentration of Triazophos to the fish, *Clarias batrachus* and reported that organophosphates are more toxic among other insecticides.

Disturbance in oxidative metabolism was observed earlier under Cypermethrin toxicity in *Labeo rohita* (Sridevi 1991) and *Tilapia mossambica* (David et al. 2003). Rao et al. (1980) showed that in case of *Labeo rohita* oxygen consumption increased progressively with increase in concentration up to certain level and decreased with further increase of toxicant until death ensured. Murthy et al. (1983) observed the same trend on *Labeo rohita* with the pesticide Fenitrothin. A similar result was obtained in the study of effect of heavy metals on oxygen consumption of freshwater mussel *Parreysia favidens* (Bhamre et al. 2004).

According to Saxena & Chauhan (1996), the reduction in oxygen consumption in *Labeo rohita* exposed under effluent was because of coagulation in gill mucus, which has resulted in asphyxiation as well as inhibition of enzyme in mitochondrial level due to toxic compounds in the effluent. Devi (2000) reported that oxygen consumption in *Oreochromis mossambicus* exposed to Endosulfan showed an initial increase in the sublethal and lethal concentrations followed by a decline in the subsequent hours.

From the study, it is observed that reduction in oxygen consumption by the whole animal may be due to the respiratory distress as a consequence of the impairment of the oxidative metabolism due to the impact caused by the pesticide Dimethoate (30% EC) and Quinalphos.

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