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Effect of Toxicity of Dimethoate on Behaviour of freshwater fish, *Arius dussumieri.*

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Abstract:

In the present study, an attempt was made to examine the lethal and sublethal toxic effect of dimethoate on behavioural aspect of freshwater fish, *Arius dussumieri.* The LC_{50} value and sublethal concentration of dimethoate for 96 hour against the freshwater fish Arius dussumieri were 5.99 and 0.599 obtained respectively. For behavioural studies, laboratory acclimatized fishes were divided into three Sets of 10 fish per aquarium. Set 'A' used as control and where water was completely dechlorinated. Set 'B' and 'C' were exposed to lethal and sublethal concentration of dimethoate solution respectively. Visual observations were made after every 24 hours upto 96 hours. Further observation was made upto 60 days for the fish exposed to sublethal concentration of dimethoate. It has been found that test fish exhibit abnormal behaviour as compare to control Set. These behavioural responses were shown to serve as sensitive indicators of pesticide pollution in aquatic organisms.

Key words: Pesticide, *Arius dussumieri,* LC_{50} Behavoiur

Introduction:

Behaviour is a instinct phenomenon through which the animal is able to adjust to changes in the environment. The initial responses to environmental changes are usually behavioural and many sense organs are exclusively sensitive to specific stimuli. Behavioural patterns are modifiable within limits, which vary according to type of nervous systems. Effector systems permit wide ranges of response to environmental stimuli, fast and slow movements, colour changes etc. Prosser, (1984) (1).Insecticides pose a constant threat to the non-target organisms in the environment as it is known that insecticides alter the normal behaviour pattern of the animals Anderson, (1971)) (2).. Pesticides are known to modify the behaviour of animals when exposed to toxic levels. The effectiveness was observed diverse and observed at different concentrations, Grant and Mehrle, (1970) (3). or they may induce maladaptive behaviour which is caused by abnormal neurophysical functions Odum *et al.*, (1969) (4)..

Pesticides may also affect locomotors orientation Rand *et al.* (1975) (5). or may affect several of the behavioural expressions of the animals Farr (1977) (6).. Alteration in the behaviour of the animal may cause total disbalancement in the ecological trophic system, as maladaptive or lethal behaviour of prey relationship, which is otherwise acutely balanced.

In the light of the above cited literature, an attempt was made to study to toxic effect of dimethoate on the behaviour. The abnormal behaviour exhibited by the fish can be taken as a useful parameter in assessing the effect of pesticides, because, the fish is very sensitive and serves as bio-indicator of aquatic pollution. All the parameters were assayed in control and experimental fish or exposed to lethal and sublethal concentration of dimethoate.

Materials and Methods:

The fishes were collected from Manjara River, Latur district and brought to laboratory. fishes were treated with 0.1 percent solution of $KmnO_4$ (potassium permagnate) for 2 minutes so as to keep away from any dermal infection. The fishes were then washed with water and acclimatized to laboratory conditions for two weeks in glass aquaria. The physico chemical parameters of water were analyzed by following standard method suggested by APHA (1998) (7). and IAAB (1998) (8).. (Table-1)

During acclimation the fish were provided with a diet consisting of live earthworms on alternate days. Food supply was withdrawn 24 hours prior to the experimentation. A commercial grade of pesticide, dimethoate (Roger) 30%EC was used for bioassay test. A stock solution of the toxicant was prepared and then few concentrations from stock solution were prepared as per the dilution technique (APHA 1998)(7). For behavioural studies, laboratory acclimatized fishes were divided into three Sets of 10 fish per aquarium. Set 'A' served as control and was kept in dechlorinated tap water.' Set 'B' and 'C' were exposed to lethal and sublethal concentration of dimethoate solution respectively. Experiment were kept under variable observation at 24 hours. interval up to 96 hours. Further observation was made upto 60 days for the fish exposed to sublethal concentration of dimethoate.

Experiments were conducted in a laboratory where there was no disturbance to the aquaria. Behavioural studies were made by following the activities of fish, *Arias dussumieri*, like jerky movement, opercular movement, swimming movement, dashing against the wall of aquarium secretion of mucous, equilibrium, colour change, gulping and surfacing activity.

Results:

In present investigation three Sets were made for behavioural studies viz. Set 'A', Set 'B' and Set 'C'.

1. Set 'A':

Set 'A' served as control. It contains ten fishes. In this Set all the fishes were alive throughout experimental period. Fishes were behaving normally and there was no mortality found. They were typically extremely vigorous and exhibit quick fine directed actions, further it seen that moderately alert yet least disturbances like touching them with a rod.

2. Set 'B':

It served as experimental Set. In this Set a set of 10 fishes were exposed to the lethal concentration i.e. LC_{50} of 96 hours. fishes were act unusual as contrast to the fishes of control Set. Various abnormal behaviors were observed like erratic movement irregular movement, jerky movement, fast swimming surfacing activity, etc. Opercular activities and mucous secretion were more as compared to the fish of control Set. In this Set fast swimming and surfacing associated with gulping activities were observed. Initially increase in gulping activity and followed by decrease. Hyper excitation followed by dashing of the fishes to the wall of aquarium was another common observation. Opercular movements increased in earlier period followed by decrease in 96 hours of exposure with slow swimming activity. Excess secretion of mucous was observed. Fishes exhibited loss of equilibrium and depigmentation at the end of experiment. The effect of lethal concentrations of dimethoate on opercular movement of test fish is represented in Table No. 1 and graphically represented in Fig. No.1.

Set 'C':

Set 'C' served as experimental Set. In this Set fishes were exposed to sublethal concentration $1/10^{th}$ of 96 hr LC_{50} of dimethoate for 60 days. In this Set also fishes behaved abnormally as compared to the fishes of normal Set. Fast swimming and surfacing associated with gulping activity was observed in test medium. Initially there was increase in gulping activity and decrease onwards. Hyper excitation followed by dashing of the fishes to the wall of aquarium. Opercular movements increased in earlier period followed by decrease in 60 days exposure period with slow swimming activity. Excess secretion of mucous was observed but in this Set no mortality was found. The effect of sublethal concentration of dimethoate on opercular movement of the fish is represented in Table No. 2 and graphically represented in Fig. No.2.

The freshwater teleost fish and the pesticide cypermethrin were used to study the behavioural aspects of the fish in pesticide toxicity. On acute exposure periods at an interval of 24 hours upto 96 hours the fish exhibited a number of abnormal behaviour such as restlessness, fast opercular movement and engulfment of air, at initial stages. Later reduced activity, erratic swimming and difficulty in respiration were evident among the treated fishes. Then there were profuse mucous secretion all over the body with the loss of balance and jerking movements. Finally, the fishes lost equilibrium, became active and lethargic along with body depigmentation and ultimately died. These behavioural responses were shown to serve as sensitive indicators of pollution load in aquatic organisms

Table 1: Effect of Lethal concentration (LC50 of 96) of dimethoate on opercular movement of *Arias dussumieri* following 96 hours exposure period

Sr. No.	Exposed Period	No. of fish Exposed	Opercular movement / min	
			Control	Experimental
01.	00 hr.	10	118	120
02.	24 hr.	10	120	128
03.	48 hr.	10	122	118
04.	72 hr.	10	120	112
05.	96 hr.	10	121	98

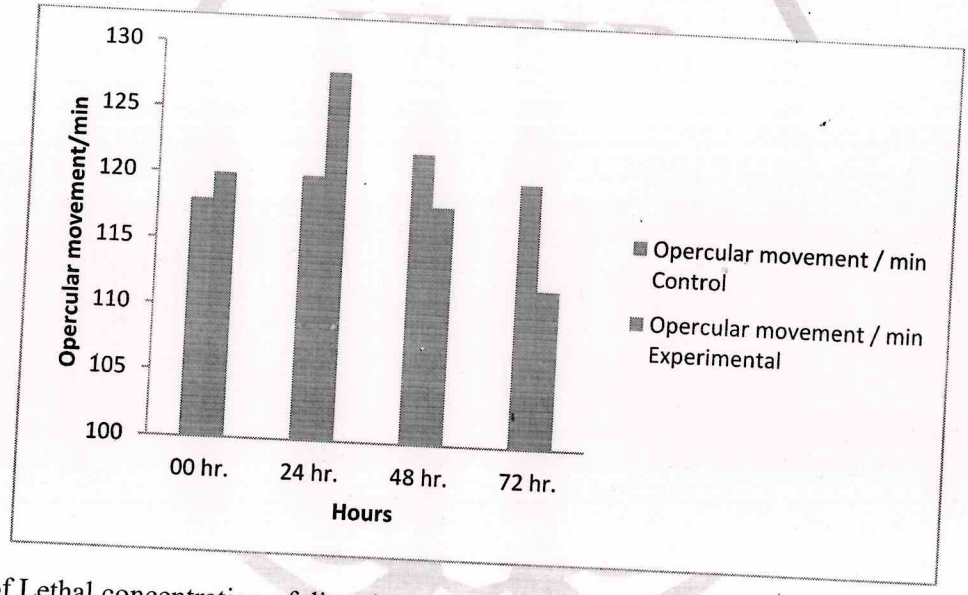

Fig: 1. Effect of Lethal concentration of dimethoate on opercular movement of *Arias dussumieri* following 96 hours exposure period

Table: 2. Effect of sublethal concentration (1/10 of LC_{50} of 96) of dimethoate on opercular movement of *Arias dussumieri* at following 60 days exposure period.

Sr. No.	Exposed Period	No. of fish Exposed	Opercular movement / min	
			Control	Experimental
01.	00 hr	10	118	120
02.	7th day	10	125	119
03.	15th day	10	124	112
04.	30th day	10	123	90

05.	45th day	10	123	76
06	60th day	10	122	63

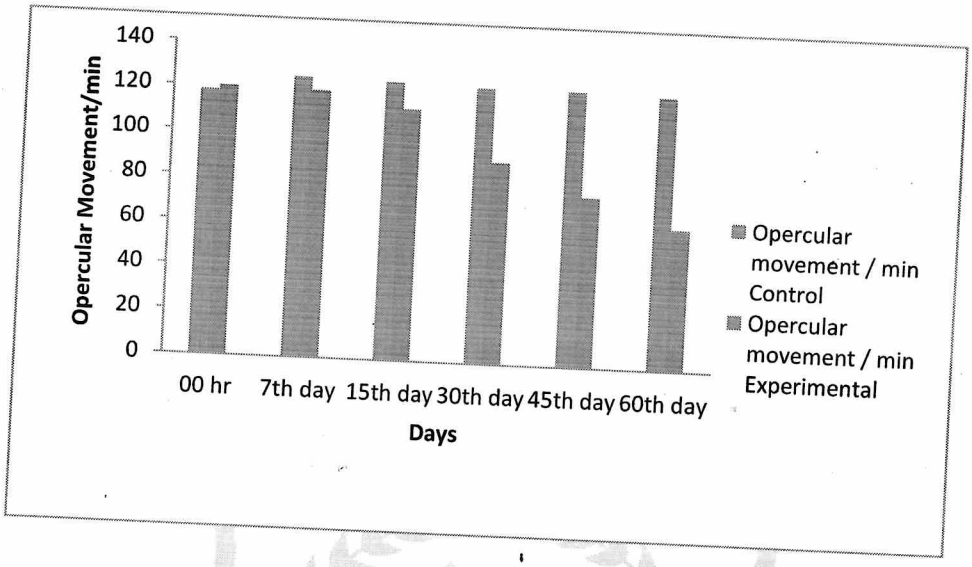

Fig: 2.Effect of sublethal concentration of dimethoate on opercular movement of *Arias dussumieri* at following 60 days exposure period.

Discussion:

Ritakumari and Nair (1978) (9). studied toxicity of insecticide, Malathion on *Lepidocephalus thermalis* and reported excitation, muscular spasm causing short, jerky movements and frequent attempts to leap out of the water in exposed fishes. Choudhary, *et.al.* (1981) (10). Studied effect of Malathion on the behaviour and body composition of *Hetropneustes fossilis* and reported decreased opercular movements in surfacing allowed and surfacing prevented conditions, with increasing concentration of Malathion. Bhaktavatsalam and Srinivas Reddy (1982) (11). Studied effect of pesticide on behevioural response in fish, *Anabas testudineus*, and reported erratic swimming, difficulty in respiration, rapid jerky movements, and alteration in opercular movements.

Anil and Ashok (1990) (12). studied effect of Malathion on skeleton anomalies in Indian catfish, *Hetropneustes fossilis* and observed behavioural changes which include irritability, loss, coordination, immobility that leads to death. Dura raj and Selvarajan (1991) (13). studied determination of sensitivity of *Tilapia mossambica* to different organophate pesticides and recorded that the abnormal behaviour which leads to loss of equilibrium...

Heath, *et al.* (1993) (14). studied effect of three pesticides on *Japanese medaka*, and observed behavioural changes include irritability, loss of coordination immobility that leads to death, skeleton abnormalities and maximum speed with spontaneous muscular activity.

Anil and Ashok Srivastava (1990) (15) and Heath (1993) (16). observed behavioural changes which include irritability, loss, coordination, immobility that lead to death, skeleton abnormalities and maximum swimming speed with spontaneous muscular activity was observed after exposure to pesticides. Saravana Bhavan, *et al.* (1997) (17). studied acute toxicity test of endosulfan and carbaryl on the freshwater Prawn, *Macrobrachium malcomsonii*, reported that the several behavioural responses, such as fast jerking frequent jumping, erratic swimming, spiriting, conclusions and tendency to escape from the aquaria, loss of equilibrium paralysis which ultimately resulted in death of the prawn.

David *et al.* (2002) (18). Studied toxicity of fenvalerate to the freshwater fish, *Labeo rohita*, and reported that the gill opercular movements increased initially support enhanced physiological activities in stressful habitat and later decreased, possibly due to mucous accumulation on gills.

Prashant, *et al.* (2003) (19). Studied effect of cypermethrin on toxicity and oxygen consumption in the freshwater fish, *Cirrhinus mrigala*, and reported that the fish maintained in normal freshwater behaved in usual manner i.e. they were very active with their well coordinated movements and alter at slight disturbance. But in toxic medium they become irritable, and hyper excited. Jumping movements as well as restlessness were observed and finally the fish turned upside down mucus secretion and loss of equilibrium was also observed. They slowly became sluggish with short jerky movement; surfacing and gulping of air and erratic circular movement finally they settled down at the bottom with loss of equilibrium and died.

Sudhanshiu Tiwari and Ajay Singh (2004) (20). found that the exposure of oleandrin, caused significant behavioural changes in *Channa punctatus*. After treatment all the experimental fishes immediately settled down of the bottom at aquarium within 5-10 mm, the breathing of fishes was affected and they come to the water air interface for air breathing. They observed that after 30-60 minutes, their swimming activity also showed down, they settled down in cluster at the bottom of the aquarium. After sometimes, the opercular movement of fishes was slowed down although they tried to stay in upper water surface. Finally all the activities ceased and at last they died. Belding (1929) (21) reported that the fish responds to toxic chemicals by increased opercular movements.

Pankaj Kumar, *et al.* (2004) (22) reported that the effect of Malathion on *Hetropneustes fossilis* showed violent jerky movement, initially increased rate of gulping of fresh air with increased opercular movement and gradual decrease with symptom of agitation, disturbances in equilibrium and breathing exposed to lethal and sublethal concentration of Malathion.

Kulkarni (2006) (23). studied comparative of toxicity of dimecron, an organophosphate insecticide to a freshwater fish, *Chela phule* and a mussel, *Lamellidens corrianus* and reported abnormal behaviour like fast swimming, surface associated with gulping activity, heperexcitation and opercular movements increased in

earlier exposure period followed by decrease in 96 hours of exposure with slow swimming activity, excess secretion of mucus was observed.

Patil, *et al.* (2006) (24). studied toxicity of organochlorine pesticide to the fish, *Cirrhina mrigala*, and observed abnormal behaviour like swimming rapid, restlessness, difficulty in respiration, convulsion, Jerky movements, more mucous secretion to avoid toxic environment and lastly looses equilibrium, becomes inverted and ultimately dies.

Tilak *et al.*, (2006) (25) studied acute toxicity of phenol to the freshwater fish, Catla *catla*, *Labeo rohita* and *Cirrhinus mrigala*, and observed that the erratic opercular movements, air bubbles were visible coming out from mouth, difficulty in respiration and convulsion were observed. Similar behavioural changes were reported in fish exposed to various pesticides (Anita Susan, 1994, (26). Vijaya Lakshmi 1994, (27). Koteshwara Rao 2003 (28).).

Behavioural studies were made by following the activities of fish, like jerky movement, opercular movement, swimming movement, secretion of mucous, equilibrium, colour change, gulping, surfacing activity, etc. In lethal concentration of dimethoate, fish behaved abnormally as compared to the control like irregular movement, Jerky movement, decrement in opercular movement, increase in surfacing activity, loss of intensity of skin colour, etc.

Raja and Kulkarni (2007) (29). studied toxicity of heavy metal, copper on freshwater fish, *Rasbora daniconius* and reported that the increased in swimming activity, breathing movement, low dose of copper (0.08 mg/l) and lethargy and loss of equilibrium at high dose of copper (0.16 mg/l).

In sublethal concentration of dimethoate, fish behaved abnormal as compared to the control, irregular and jerky movement at the end of experiment. Opercular movement increase first and then decrease upto end of experiment. Surfacing activity increased loss of intensity of skin colour etc. during experimental period.

Imtiyaz Qayoom *et al.* (2016) (30). investigate acute toxicity of dimethoate on juvenile *Cyprinus carpio* in this study they seen various behavioral responses viz. uncoordinated movements, convulsions, excessive mucus secretion, and unprovoked swimming which ended in a collapse to the bottom of the aquarium. Prior to death, the clinical signs like scale attrition, pale body color, and hemorrhagic patches over the body were noticed which became more vivid up to the termination of experiments. Results of the study indicate potential toxicity of dimethoate in fingerlings of common carp

In the present investigation the irregular and jerky movement of *Arias dussumieri* exposed to dimethoate suggests loss of equilibrium. It might be due to reduction in conduction of nerve impulses and potential of nerves system. Probably caused by brain damage or inhibition of acetylcholine secretion. Increased surfacing activity and decrement in opercular movement of fish exposed to lethal and sublethal concentration of dimethoate suggest respiratory distress. It might be due to reduction in the respiratory potentials of the gill tissue, probably caused by tissue damage.

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