

Impact of Methyl Parathion (An Organophosphate) on the Behavioral Response of *Heteropneustes Fossilis* (Bloch)

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ABSTRACT

To study the acute toxicity of Methyl Parathion to the freshwater food fish *Heteropneustes fossilis* exposed to this concentration. Behavioral changes (Resting period, opercular movement, air gulping and s- jerks and mucus secretion) were observed during acute exposure. The present investigation has been designed to study the effect of sub lethal concentrations of Methyl Parathion on the behavior changes of *Heteropneuste fossilis* (Bloch) after exposure to different doses. The present study shows that behavioral alterations such as alternation in opercular movements, surfacing, swimming, jumping, and mucous secretion.

Keywords: Behavior, Methyl Parathion, *Heteropneustes fossilis*, sublethal concentration

INTRODUCTION

Behavior provides a unique perspective linking the physiology and ecology of an organism and its environment: (Little and Brewer 2001). Alterations in fish behavior, particularly in non-migratory species can provide important indices for ecosystem assessment. Any change in the behavior of fish indicates the deterioration of water quality, as fish are the biological indicator and hence index of environmental suitability and the cost of survival (Halappa and David, 2009). Pesticides in sub lethal concentrations present in aquatic environment are too low to cause rapid death directly but may affect the functioning of the organisms, disrupt normal behavior and reduce the fitness of natural population (Susan *et al.*, 2010).

Methyl Parathion is a nonsystematic, wide spectrum organophosphate insecticide. This is used for agricultural and nonagricultural purposes. Once Methyl Parathion is introduced into the environment, usually from spraying on crops, droplets of Methyl Parathion in the air fall on soil, plants, water or manmade surfaces. While most of the Methyl Parathion will stay in the areas where it is applied, some can move to areas away from where it was applied by rain, fog and wind. Methyl Parathion may cause serious intimidation to the aquatic organisms and is notorious to cause severe metabolic disturbances in non-target species like fish (USEPA, 2005). Pesticidal impact on the life of aquatic organisms is often acute resulting in mass mortality or chronic changes in behavior. Such behavioral alterations are very sensitive indicators of stress imposed on fish by the environment. In the present paper an attempt has been made to study the toxic effect of different concentrations of Methyl Parathion on behavioral parameters of *Heteropneustes fossilis* for 30 days.

Pesticides include a wide variety of chemicals with great difference in their mode of action, uptake by the body, metabolism and elimination from the body and toxicity to target and non-target organisms. The widespread use of pesticides not only brought adverse influence on agro ecosystems but also caused alteration in physiological processes of non-target organisms. These pesticides through surface runoff reaches into the water bodies like ponds and rivers which alters the physicochemical properties of water and is toxic to aquatic organism and cause deleterious effect or even death to the aquatic animals. Poisoning risks depend on dose, toxicity, duration of exposure and sensitivity. Application of organophosphorus insecticides in crop field has a great impact on aquatic system especially on fish population. In spite of terrible impact of pesticide on aquatic environment, it is vastly used in agricultural sector (Kadam and Patil, 2016). These pesticides enter the food

chain and their subsequent bioaccumulation and biotransformation at different trophic levels have catastrophic effect to the ecosystem (Grande *et al.*, 1994). During the last two decade a tremendous progress has been made in the development of new compounds with better toxicity, therefore, a lot of work has been carried out on impact of pesticides on non-target aquatic organisms. Organophosphates are highly toxic to fish and non-target aquatic organisms and are powerful nerve poisons, since they inhibit AChE activity (Klaverkamp and Hobden, 1980). Methyl Parathion, a broad spectrum organophorous insecticide used against pod borers, fruit borers, stem borers, leaf miners, defoliating caterpillars, sucking pests, termites etc and in other settings, to kill a number of pests, including insects and worms. It acts on the nervous systems of insects by inhibiting the acetylcholinesterase enzyme. Methyl Parathion is considered moderately hazardous to humans by the World Health Organization based on its acute toxicity (WHO, 2010). It enters into the aquatic ecosystem and affects aquatic organism (Chernyak *et al.*, 1996; Livingstone, 2001). Poisoning from Methyl Parathion may affect the central nervous system, the cardiovascular system, and the respiratory system as well as a skin and eye irritant of fish (Cox, 1994; 1995). The toxicity study is essential to find out toxicants limit and safe concentration, so that there will be minimum harm to aquatic fauna in the near future. Tiwari *et al.*, (2019) also conducted similar studies in plants. Among the several aspects of toxicity studies, the bioassay constitutes one of the most commonly used methods in aquatic environmental studies with suitable organisms. The necessity of determining the toxicity of substances to commercially aquatic forms at the lower level of the food chain has been useful and accepted for water quality management (Zahan *et al.*, 2019). The fishes, best indicator of water body pollution, are the most sensitive of all aquatic animals. Fish is an important source of protein and easily digestible food for human being. It plays a vital role to fulfill our nutritional requirement. However, now a days due to different natural and anthropogenic activities, fish production in natural waterbodies are declined due to unexpected temperature variation, unfavorable pH, dissolved oxygen, dissolved solids, application of pesticides and biological agents like parasites, bacteria, virus, fungus etc. are the main causes of declining the fish population (Siddiqua *et al.*, 2016). In many countries, large scale mortality of fishes has been recorded due to pesticides in water bodies as pollutants (Nikam, 2011). Biochemicals are the most assessable body contents for checking the toxicity of any chemicals. Any alternation in biochemical parameters can result in serious outcomes in the form of various diseases in both the animal and its consumers. Several studies have been conducted in assessing the toxicity of organophosphorous insecticides on different fish species (Verma *et al.*, 1982; Hoque *et al.*, 2000; Vasit and Patil, 2005; Thenmozhi *et al.*, 2011; Sharmin *et al.*, 2014; Palanikumar *et al.*, 2014; Prakash and Verma, 2014, Verma and Prakash, 2018 and Kadam and Patil, 2016; Kaur and Mishra, 2019). Perusal of literature reveals paucity of information on acute toxicity of Methyl Parathion on freshwater fishes such as *Heteropneustes fossilis* which are nutritional and popular fish in the study area. In the present study, an attempt was made to examine the toxic effects of Methyl Parathion on the serum biomolecules of freshwater catfish, *H. fossilis*.

MATERIALS AND METHODS

Live specimens of *Heteropneustes fossilis* (10-12 cm in length and 4-6 gm in weight) were collected locally. Fishes were washed with 0.5% KMnO₄ solution for five minutes to remove external infections and then acclimated in dechlorinated tap water under laboratory condition for a period of 15 days prior to experiment. Commercial fish food was given to fishes. Three different concentrations 25 mg/L, 50 mg/L and 75 mg/L were taken for behavioural studies. Resting period and Opercular movement was recorded for one minute and gulping of air calculated for fifteen minutes (Gupta and Dua 2010). S jerk were recorded for 15 mins. All the parameters were recorded for 30 days and the results of the observations are expressed in mean values and standard deviations.

Collection of mucus from fish

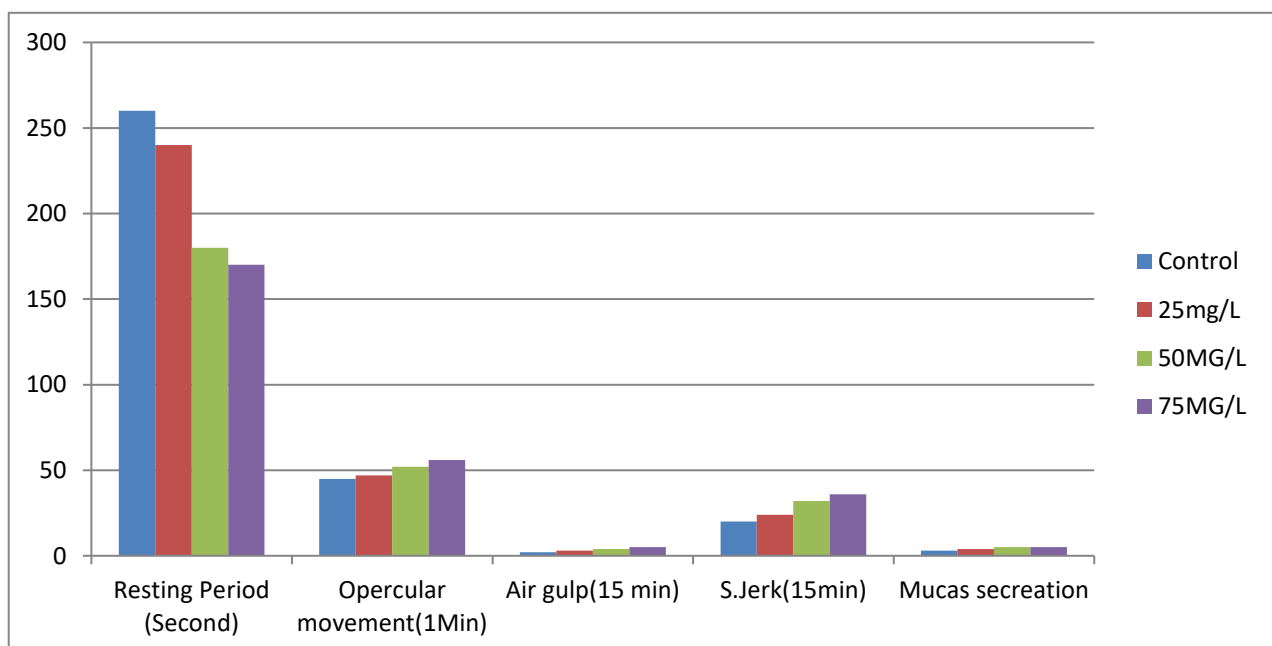
Mucus was carefully scraped from the dorsal side of the body using a sterile spatula. Mucus was not collected from the ventral side to avoid intestinal and sperm contamination. The collected fish mucus was stored at 4°C for further use. 5ml of the mucus samples were collected aseptically from the fish and thoroughly mixed with equal quantity of sterilized physiological saline (0.85% NaCl) and the mixture was centrifuged at 5000 rpm for 15 minutes. The supernatant was collected and stored at 4°C for studying.

RESULTS AND DISCUSSION

Changes in behavioral responses of fishes started 30mins after dosing. Fishes exposed to Methyl Parathion showed speedy movements as compared to control. This resulted in decrease in resting period. The normal resting period between each swimming action in control was 260.01 ± 1.88 seconds whereas this period decreased with an increase in pesticide concentrations. In 25mg/l dose exposure to *H.fossilis* Resting period is 240.83 ± 1.20 , seconds in 50mg/L IS 180.15 ± 2.20 seconds in 75mg/L resting period is 170.32 ± 2.15 . The opercular movement per minute showed increasing trend with the increase in concentration of pesticide. Methyl Parathion exposure caused hypoxia which was reflected in the number of air gulps per 15 mins. Number of air gulps increased from 1.05 ± 0.26 in control group to 2.70 ± 0.42 , 3.68 ± 0.50 and 5.80 ± 0.32 in the group exposed to Methyl Parathion at 25mg/l, 50mg/L and 75mg/L respectively. Movements like S jerking, (20.53 ± 1.26 to 36.07 ± 2.02) mucus secretion is increased when compared with control. Threat and burst swimming were increased in the experimental fishes when exposed to Methyl Parathion. The increase in swimming activity may be due to disruption of shoaling behavior which occurs because of the stress of the toxicant (Venkata et al., 2008). Fast swimming was also observed by Yaji et al (2011) in *Oreochromis niloticus* treated with Cypermethrin. Under toxic condition the oxygen supply becomes deficient and so the fish breathe rapidly (Susan et al., 2010). Increase in opercular movement has also been reported by Srivastava *et al.*, (2010) in *Heteropneustes fossilis* exposed to Dimethoate respectively. Rapid opercular movement was also confirmed by Wasu *et al.*, (2009) in *Clarias batrachus* treated with Carbaryl and Methyl Parathion. Gulping of air may help to avoid contact of toxic medium (Katja *et al.*, 2005). S jerk and burst swimming were also observed by Marigoudar *et al.*, (2009) in *Labeo rohita* exposed to cypermethrin

Table 1: Effect of Methyl Parathion doses on different behavioral parameters of *Heteropneustes fossilis*

Parametars	Control	25mg/L	50MG/L	75MG/L
Resting Period (Second)	260.01 ± 1.88	240.83 ± 1.20	180.15 ± 2.20	170.32 ± 2.15
Opercular movement(1Min)	45.21 ± 2.80	47.24 ± 2.99	52.91 ± 2.12	56.84 ± 2.21
Air gulp(15 min)	1.05 ± 0.26	2.70 ± 1.02	3.68 ± 0.50	5.80 ± 0.32
S.Jerk(15min)	20.53 ± 1.88	24.23 ± 1.02	32.56 ± 1.66	36.07 ± 2.02
Mucas secretion	3ml	4ml	5ml	5.5ml



Graph1. Graphical representation Effect of Methyl Parathion doses on different behavioral parameters of *Heteropneustes fossilis*

CONCLUSIONS

On the basis of the observations made in the above study it is possible to conclude that impact of Methyl Parathion on fish behavior is dose dependent. As the concentration increases the number of behavioral alterations also increases. The sublethal concentrations of Methyl Parathion may adversely affect the survivability of the fish in their natural environment. So care should be taken regarding dosage and time of application when Methyl Parathion is used for pest control in agricultural field or tea gardens surrounding the aquatic bodies.

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