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Alterations in Respiration and Behavior of *Channa punctatus* (Bloch.) Exposed to Endosulfan

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ABSTRACT: The present study was undertaken to evaluate the sublethal toxicity of Endosulfan, an organochlorine pesticide as well as alterations in respiration and behavior in *Channa punctatus* (Bloch.). The fish were exposed to sublethal concentrations of pesticide for 24, 48, 72 and 96 hours for the study of acute toxicity. Decrease in the Oxygen uptake efficiency and excitability, fast jumping, swimming pattern, necrosis of fins, surfacing and gulping, lightening of the body colour as well as increased mucus secretion were noted.

KEYWORDS: *Channa punctatus*, respiration, behavior and Endosulfan.

I. INTRODUCTION

Due to human population growth and industrial development water has been contaminated around the world during recent years. The disposal of the industrial and agricultural wastes directly into the aquatic medium burdens the ecosystem and stresses the need to analyze the concentration of these substances in the medium as well as in the organisms. Most of these contaminants are either Oxygen depleting, where they deplete the Oxygen of requisite water bodies, some of them are toxic as they produce some toxic substances that can prove harmful and fatal for life to survive, also many of them are capable of blocking the sunlight which in turn restricts the normal cycles for survival of life (Prasad, 2012). The behavioral changes constitute an index to measure the toxicity of any toxicant. Respiration is an important and vital physiological process occurring in all living cells. It is an oxidative, exothermic and catabolic reaction during which food materials undergo oxidation and get converted into carbon dioxide, water and energy. The respiratory potential or Oxygen consumption of an animal is the important physiological parameter to assess the toxic stress, because it is a valuable indicator of energy expenditure in particular and metabolism in general. Contamination of surface waters has been well documented worldwide and constitutes a major issue at local, regional, national and global levels (Cerejeira *et al.*, 2003). The agricultural waste products run off to the nearby water bodies and rivers. The unregulated release of agrochemicals into water bodies has caused serious environmental problems to all classes of organisms in aquatic habitat (Haloi *et al.*, 2014).

Endosulfan was one of the most commonly used organochlorine pesticides which was used for pest control in all types agricultural crops. Endosulfan is registered as a fish toxicant (French *et al.*, 1957). It has been banned by the honourable Supreme Court of India w.e.f. 13-05-2011 for production, use and sale, all over India, till further orders vide ad-Interim order in the Writ Petition (Civil) No. 213 of 2011 (CIBRC, 2013). Determination of respiratory rate of aquatic animals will undoubtedly provide information on the effects of toxicants on the physiology of aquatic life. Total Oxygen consumption is one of the indicators of the general well being of the fish. It may also be useful to assess the physiological state of an organism, helps in evaluating the susceptibility or resistance potentiality and also useful to correlate the behaviour of the animal, which ultimately serve as predictors of functional disruptions of population. Hence the analysis of Oxygen consumption can be used as a biodectory system to evaluate the basic damage inflicted on the animal which could either increase or decrease the Oxygen uptake. The presence of dissolved Oxygen is essential to maintain the higher form of biological life and keep the proper balance of various populations

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making water body healthy. Dissolved Oxygen (DO) is essential for the maintenance of healthy lakes and rivers. It is a measure of the ability of water to sustain aquatic life. The presence of Oxygen in water is a good sign. Thus DO test is the basis for testing BOD which is an important parameter to evaluate organic pollution potential of a waste.

In the present investigation, it has been tried to assess Endosulfan altered respiratory as well as behavioral responses in *Channa punctatus* which can be used as bioindicator for assessing pesticide toxicity to fish.

II. MATERIAL AND METHODS

The commercial grade Endosulfan was purchased from the local market in 2010. The fish, *C. punctatus* (average length 11.582 ± 0.564 cm and average weight 15.856 ± 0.877 gm) of both sexes were collected from local market of Amalner, carefully brought to the laboratory avoiding any injury to the fish during transport. The fish were disinfected with 0.05% solution of $KmNO_4$ for two minutes and then transferred to a 45 litre capacity aquarium to acclimatize for 15 days in laboratory conditions. The fish were fed daily in the morning with chopped goat liver, boiled egg, meat, boiled intestine of goat, chicken as well as pieces of earthworm. After acclimatization, fish were kept in different concentrations of Endosulfan in to 2 litre capacity plastic jars. LC_{50} was determined by as per the method of Finney (1971). The test stock solution was made by adding requisite quantity of tap water to the stock solution and the dosages were determined in ppm. The toxicity of the Imidacloprid on the fresh water fish, *Channa punctatus* was assessed and determined LC_{10} and LC_{50} for 24, 48, 72 and 96 hrs by probit analysis as per Organisation for Economic Co-operation and Development (OECD) guidelines for testing of chemicals (OECD 203 "Fish, acute toxicity test", 2010). Fish were exposed to sublethal concentration (0.0001ppm) of Endosulfan for 24, 48, 72 and 96 hrs respectively in acute toxicity studies. Winkler (1888) method was used to estimate O_2 consumption.

In the present study, the consumed O_2 was measured from 24 hrs to 96 hrs with an interval of 24 hrs. Eight fish were taken in each interval for each experimental as well as control groups and observed behavioural changes. At the end of 24hrs exposure, each fish was transferred from the test chamber (2 litre capacity jar) to another chamber of 2 litre capacity jar containing fresh water. The fish were allowed to stabilize for five minutes and then the experiment was run for a period of 1hr. The same procedure was repeated for 48, 72 and 96hrs. Controls were also run simultaneously to obtain information on the Oxygen consumption and behaviour of the fish in normal state. The Oxygen consumed by the fish was expressed as mg/l/hr/gm body wt. The respiratory measurements were done in diffused daylight and the time of the experiment was kept constant (10.00 am to 3.00 pm) to avoid the effect of time of day on the respiration of the fish at temperature $24 \pm 1^{\circ}C$ and pH 7.5 ± 0.3 . The pH and water temperature were measured by using pH meter (Japan) and thermometer, respectively. The mean values of treatment were subjected to statistical analysis using one-way analysis of variance (ANOVA) to test for the level of significance of difference between the means of control, exposed fish and after 10 days recovery period of sublethal concentration of Endosulfan. All statistical analyses were performed by using the Minitab 17). Results were considered significant at the 0.05 level.

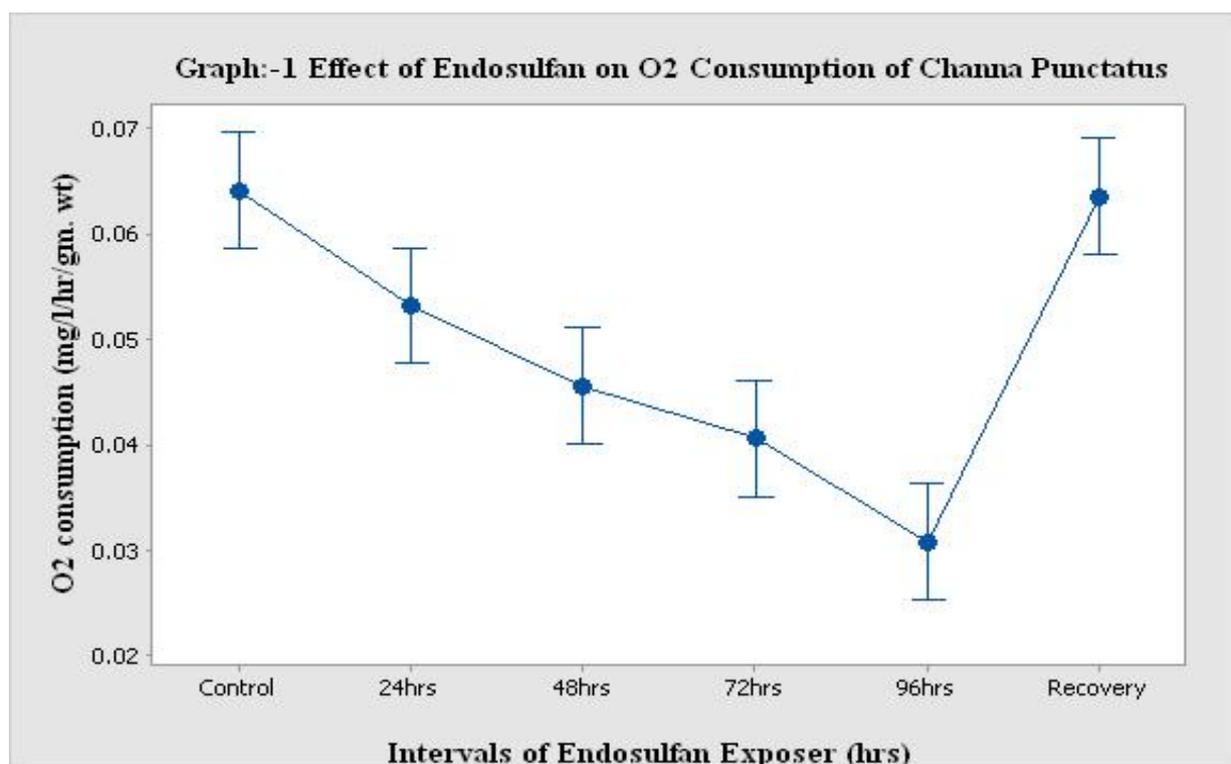
III. RESULTS

For the present study an attempt has been made to study effect of Endosulfan on Oxygen consumption of fresh water fish *Channa punctatus*. Reduced Oxygen consumption and behavioural changes in *C. punctatus* after acute exposure to sublethal concentration of Endosulfan and recovered respiration rate after 10 days in fresh water have been observed. The fish were exposed to 96hrs sublethal concentration (0.0001ppm).The result indicates that the rate of Oxygen consumption decreased in 24-96 hours in sublethal concentration compared with control as well as after 10 days recovery.

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Period	Control	24 hrs	48 hrs	72 hrs	96 hrs	Recovery
O ₂ consumption mg/l/hr/gm. wt	0.06420 ±0.009	0.05320 ±0.003	0.04560 ± 0.004	0.04060 ±0.005	0.03080 ±0.005	0.06360 ±0.006

Table 1: Oxygen consumption by *Channa punctatus* after exposure to Endosulfan and recovery period

Normal value of Oxygen consumption was 0.06420 ± 0.009 mg/l/hr/gm body wt. for control. In Endosulfan acute studies, values of Oxygen consumption were 0.05320 ± 0.003 , 0.04560 ± 0.004 , 0.04060 ± 0.005 as well as 0.03080 ± 0.005 and 0.06360 ± 0.006 mg/l/hr/gm body wt., after 24, 48, 72 as well as 96hrs exposure to Endosulfan and recovery after 10 days respectively (Table 1). Values of O₂ consumption represented graphically (Graph 1). Decreased Oxygen consumption, lightening of the body colour, jumping movements, imbalance in posture, increase in surfacing activity as well as increased opercular movement, gradual loss in equilibrium and hypoactive reported at sublethal concentrations in *Channa punctatus* exposed to Endosulfan.

IV. DISCUSSION

Many authors investigated pesticide toxicity induced respiration and behavioural changes in fish. It is easily detectable through changes in Oxygen consumption rate, which frequently used to evaluate the changes in metabolism under environment deterioration (Magar and Shaikh, 2012). In the present investigation LC₅₀ 96 hrs value of Endosulfan to *C. punctatus* was found to be 0.00018 ppm. The depletion of the Oxygen consumption was caused by rupture in the respiratory epithelium of the gill tissue. As per results, Oxygen consumption is decreased when the time of exposure to toxicant is increased. The respiratory potential and the Oxygen consumption of an animal are the important physiological parameters to assess the toxic stress because it is a valuable indicator of energy expenditure during metabolism (Proser and Brown, 1973). Nataranjan (1981) noticed decreased Oxygen consumption in *C.*

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punctatus exposed to organophosphate pesticide. Ali (1982) observed reduced respiration rate in fresh water fish, *C. punctatus* on exposure to Demecron. Susan *et al.* (2010) reported decrease Oxygen consumption in *Labeo rohita*, *Catla catla* and *Cirrhinus mrigala* exposed to sub lethal concentrations of Fenvalerate. Similar observation was also noted in *Labeo rohita* exposed to Sodium cyanide (Prashant *et al.*, 2011) as well as in *Oreochromis niloticus* exposed to *Abamectin* (Al-Kahtani, 2011). Manjula and Veeraiah (2014) also reported decreased Oxygen consumption of freshwater fish *Cirrhinus mrigala* (Ham.) after Cypermethrin exposure. Reduction in Oxygen consumption and swimming pattern, necrosis of fins, surfacing and gulping, lightening of the body colour as well as increased mucus secretion were noticed in *Channa gachua* to Imidacloprid exposure (Neonicotinoids) (Pawara and Patel, 2012). Behavioral characteristics are obviously sensitive indicators of toxicant effect. Organism's behaviour in the field in order to derive a more accurate assessment of the hazards that a contaminant may pose in natural system, should be considered for species forming social organization. Prashant *et al.* (2011) observed jumping movements, restlessness, turning upside down, excess mucus secretion as well as loss of equilibrium, sluggish body with short jerky movements as well as increased surfacing and gulping of air and erratic circular movements in *Labeo rohita* after exposure to Sodium cyanide. Ganeshwade *et al.* (2013) reported behavioral changes such as irritation, fast opercular movements, violent actions of pelvic fin as well as spreading of the fins, loss of equilibrium and mucus covering on freshwater fish *C. striatus* after exposure to Endosulfan. Erratic swimming, hyper and hypoactive, imbalance in posture, increase in surfacing activity, opercular movement, gradual loss in equilibrium and spreading of excess of mucus all over the surface of the body were observed in *Catla catla* exposed to Copper cyanide (Prashanth, 2010). Patel *et al.* (2000) noticed hyperactivity and erratic movements in *Nemacheilus botia* exposed to sublethal doses of Dimecron. Occasionally jumping movements, increased opercular movement, increased mucus secretion and abnormal swimming movements were observed in *Heteropneustes fossilis* exposed to Dimethoate (Srivastava *et al.*, 2010). Sarma *et al.* (2013) observed abnormal swimming pattern, increased jumping, faster opercular activity, erecting dorsal and ventral fin in *Channa punctatus* after exposure to Rogar.

In the present study, lightening of the body colour, jumping movements, restlessness and loss of equilibrium were noted in response to Endosulfan treatment. The results of present investigation are in consonance with the observations of above workers as far as changes in Oxygen consumption and behavior of the fish are concerned on exposure to Endosulfan.

V. CONCLUSION

An attempt has been made in the present investigation to determine the acute toxicity of Endosulfan on respiration and behaviour of *C. punctatus*. This also provides a platform to establish tolerable limits and safe levels of toxic agents for the biota of aquatic environment and to save the residue imbalance in aquatic bio-ecological cycles, which helps in involving bio-detector monitoring. These results indicate that Endosulfan tested concentration is toxic to fish and undesirable chemicals in edible fish tissue can affect the health of human beings consuming these fish. The present research work can also serve as an experimental tool and bioindicator for the first line evaluation of environmental pollution. Authors suggest that the farmers should wisely use this type of deadly pesticides and help to maintain ecological imbalance.

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