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EFFECT OF CARTAP HYDROCHLORIDE (50% SP) ON OXYGEN CONSUMPTION OF FRESH WATER FISH, *CIRRHINUS MRIGALA* (HAMILTON)

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ABSTRACT

Effect of Cartap hydrochloride on oxygen consumption of the Indian major carp, *Cirrhinus mrigala* was studied. Fingerlings were exposed to sub-lethal (0.0376 mg^{-1}) and lethal (0.376 mg^{-1}) concentrations of Cartap hydrochloride for 24,48,72 and 96hrs. In both sublethal and lethal concentrations for all exposed hours *Cirrhinus mrigala* showed an increased tendency in oxygen consumption during the initial time of exposure and a gradual decrease during the subsequent study period. Alterations in oxygen consumption may be due to respiratory distress as a consequence of impaired oxidative metabolism. Present study showed that Cartap hydrochloride altered respiratory metabolism in *Cirrhinus mrigala* which can be used as bio-indicator for assessing pesticide toxicity to fish.

KEYWORDS: Cartap hydrochloride, *Cirrhinus mrigala,* Oxygen consumption.

INTRODUCTION

Wide and indiscriminate use of pesticides in modern agricultural practices throughout the world has indirectly created problem of pollution of aquatic ecosystems. (Ganeshwade, 2012). These chemicals impair water quality which become unsuitable for all aquatic organisms due to their toxicity, persistence, bioaccumulation, and biomagnification in food chain and ecological balance (Subramani Lavanya *et al.,* 2011). Fish accumulate these pollutants directly or indirectly from polluted waters and food chain (Jabeen *et al*., 2016). In India, Cartap hydrochloride a carbamate pesticide is extensively used in rice and sugarcane crops to control pests. One of the indicators of the health status of a fish is its total oxygen consumption. It helps in evaluating the susceptibility or resistance potential useful to assess the physiological condition of an organism and to correlate the behavior of the animal, which ultimately serve as predictors of functional disruptions of population. Hence the analysis of total oxygen consumption can be used as a biodetectory system to evaluate the basic damage caused to the animal which could either decrease or increase the oxygen uptake (Maharajan *et al.,* 2013). In this viewpoint an attempt was made to study the effect of sublethal and lethal concentrations of Cartap hydrochloride on oxygen consumption of freshwater fish, *Cirrhinus mrigala* exposed for 24,48,72 and 96hrs.

MATERIALS AND METHODS

Experiment on the oxygen consumption of the fish *Cirrhinus mrigala* was carried out in a respiratory apparatus developed by Job (1955). The fingerlings of the test fish *Cirrhinus mrigala* of size 6-8 ± ½ cm and weight 6-7 ± ½ g were procured from local fish hatcheries of Nandivelugu, Tenali mandal, Guntur district, Andhra Pradesh. The fish were acclimated at (28±2 ^{o}C) in the laboratory conditions for two weeks. All the precautions laid down on recommendations of the toxicity tests to aquatic organisms were followed (Annon, 1975). Fish were regularly fed with rice bran and one day prior to the experimentation feeding was stopped. Fish were exposed to sub-lethal ($1/10^{th}$ of 96 h LC_{50} value 0.0376 mg^{-1}) and lethal (96 h LC_{50} value 0.376 mg^{-1}) concentrations of Cartap hydrochloride for 24,48,72 and 96 hrs. The samples for estimation of oxygen consumption were taken from the respiratory chamber, at alternate hours of intervals for 24hours. The amount of dissolved oxygen consumption was calculated per gram body weight per hour. The dissolved oxygen content was estimated by modified Winkler's method as described by Golterman and Clymo (1969). The difference in the dissolved oxygen content between initial and final water samples represents the amount of oxygen consumed by the fish.

Student's t-test was employed to calculate the significance of the differences between control and experimental means. P values of 0.05 or less were considered statistically significant (Fisher, 1950).

RESULTS

The results of the experimental and control fish values are graphically represented in Figures 1,2,3 and 4 by taking hours of exposure on X axis and the amount of oxygen consumed per gram body weight per hour on Y axis.

In sublethal concentrations of Cartap hydrochloride it was observed that the fish showed increase in oxygen consumption during the initial time of exposure i.e., 0-6 hours in 24 and 48 hour treated fish and 0 to 4 hour in 72 and 96 hour treated fish and a gradual decrease was observed in the subsequent periods of study. The presence of sub

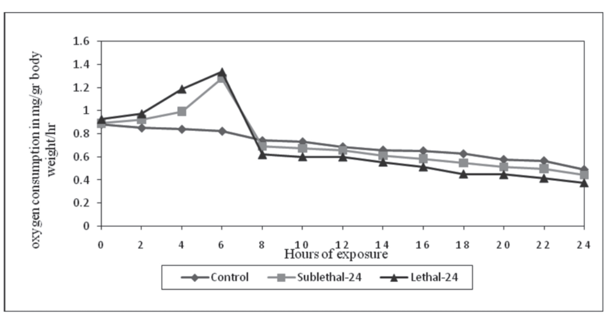

Fig. 1. The amount of oxygen consumed in mg/g body weight/hr of Cirrhinus mrigala exposed to sublethal and lethal concentrations of Cartap hydrochloride for 24 hrs

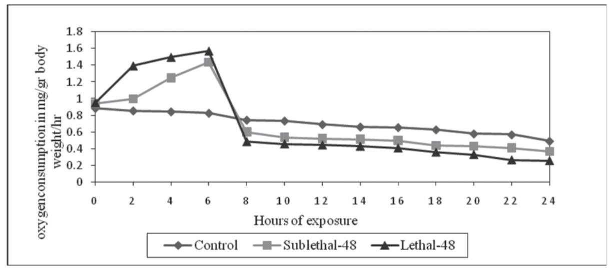

Fig. 2. The amount of oxygen consumed in mg/g body weight/hr of *Cirrhinus mrigala* exposed to sublethal and lethal concentrations of Cartap hydrochloride for 48 hrs.

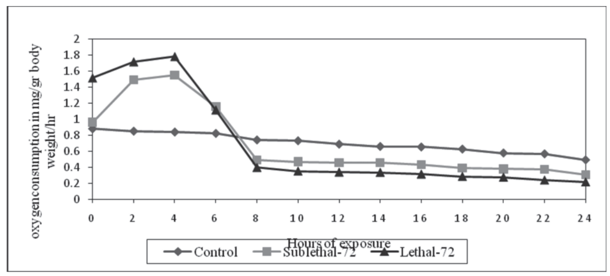

Fig. 3. The amount of oxygen consumed in mg/g body weight/hr of *Cirrhinus mrigala* exposed to sublethal and lethal concentrations of Cartap hydrochloride for 72 hrs.

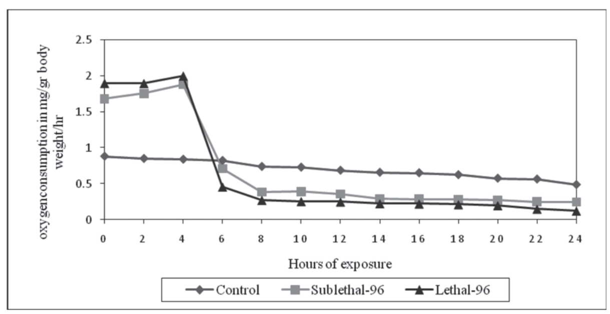

Fig. 4. The amount of oxygen consumed in mg/g body weight/hr of *Cirrhinus mrigala* exposed to sublethal and lethal concentrations of Cartap hydrochloride for 96 hrs.

lethal concentration of toxicants is aquatic environment is inevitable. The toxicant stress on oxygen consumption along with depletion in oxygen in aquaculture practices makes fish less fit and reduces their growth due to lack of proper metabolism (Hyma Ranjani, 2015 and Bantu *et al*., 2017). In lethal concentrations of Cartap hydrochloride it was noticed that a gradual increase in oxygen consumption during the initial time of exposure i.e., 0-6 hours in 24 and 48 hour treated fish and 0 to 4 hour in 72 and 96 hour exposed fish and a gradual decline is observed during the later periods of study. In control fish the rate of oxygen consumption gradually decreased, and this might be due to starved conditions and the reduced metabolic rates of the starved fish (Anitha, 2015). From the present study it is clear that the Cartap hydrochloride affected oxygen consumption of *Cirrhinus mrigala* under all hours of exposure in both sublethal and lethal concentrations.

DISCUSSION

Several authors reported the effect of carbamate pesticides on the oxygen consumption in fish. Mariya Dasu (2014) observed initial increase in oxygen consumption in *Labeo rohita* exposed to Thiocarb. Anitha (2015) also observed increase in oxygen consumption during the initial time of exposures, i.e. 1 to 6 hours and a gradual decrease was observed during the subsequent period of study in *Labeo rohita* exposed to Pyraclostrobin. In lethal concentrations the rate of oxygen consumption showed a decreasing trend from the beginning to the end. Bantu *et al.*, (2017) observed increase in oxygen consumption during the initial time of exposures i.e., 1 to 4 hours and a gradual decrease during the subsequent period in *Labeo rohita* exposed to sublethal concentrations of Indoxacarb for 24hrs and 8 days. Oxygen consumption decreased in *Labeo* during exposure to lethal concentrations of indoxacarb for 24 hours.

The initial increase in oxygen consumption in the present study is in agreement with Neelima *et al.*, (2016) in *Cyprinus carpio* exposed to cypermethrin, Jothinarendiran (2012) in *Channa punctatus* exposed to dimethoate, Bantu *et al.*, (2017) in *Labeo rohita* exposed Indoxacarb, Tilak and Vijaya kumar (2009) in *Channa punctatus* exposed to Quinaphos, Veeraiah (2001) in *Labeo rohita* exposed to Cypermethrin. Hyma Ranjani (2015) in *Catla catla* exposed to Glyphosate. The present work coincides with the report of the same.

The initial increase in oxygen uptake in sublethal concentration might be the reflection of an augmented physiological activity for elimination acting the chemical stress (Tilak and Vijaya kumar, 2009). Due to stress, muscular activity increases which results in an increased demand for oxygen. The increase in activity might boost up oxidative metabolism which results in increased supply of energy to combat the chemical stress (David *et al.*, 2003). Sree Veni and Veeraiah (2014) reported that due to stress there is increased respiratory activity, resulting in increased ventilation and increased uptake of the toxicant in *Cirrhinus mrigala* exposed to cypermethrin.

Several authors (Veenethkumar and David, 2008; Shereena *et al.*, 2009; Logaswamy and Remia, 2009) reported that alteration in whole animal oxygen consumption is due to the disturbance in oxidative metabolism in different species of fish exposed to pesticides. During the initial hours of exposure elevation in the rate of respiration could be explained in terms of acceleration of oxidative metabolism, as a result of sudden response to the toxic stimulus of the pesticide. With the onset of symptoms of poisoning, probably due to acclimatization to the chemical environment the rate decreased in the later periods of exposure. Similar observations were also made by Neelima *et al.*, (2016) and Jothinarendiran (2012). The results of the present study agree with above findings.

As the pesticides stimulate the peripheral nervous system, the activity of fish increases which requires more oxygen to fulfill the energy demand. This could be the reason for initial elevation in the rate of oxygen consumption (Rao, 1989). In sub lethal medium, in the subsequent period of exposure the respiration rate of fish decreased which might be due to acclimatization of the fish in the chemical environment (Rao, 1989 and Neelima *et al.*, 2016). Under toxic conditions, the oxygen in take decreases and a number of poisons become more toxic, so the amount of poison being exposed to the animal also increases. Fish breath more rapidly and the amplitude of respiratory movements will increase (Vakita Venkata Rathnamma and Nagaraju Bantu, 2014). By triggering the process of detoxification, the fish might have overcome the pesticide toxicity.,

In the later period the decrease in oxygen consumption appears to be a protective measure to ensure that there is low intake of the toxic substances which agrees with Tilak and Vijaya Kumar (2009). Subsequent decrease in oxygen consumption may be due to increased entry of Cartap hydrochloride molecules or their accumulation in the body of fish as a function of time. In sub lethal concentrations of the Cartap hydrochloride the decrease in oxygen consumption appears to be mainly due to lowering down of energy requirements which can be considered as adaptive and even strategic which is in accordance with findings of Tilak and Vardhan, (2002). Depletion in the oxygen consumption is due to disorganization of the respiratory action caused by rupture in the respiratory epithelium of the gill tissue and also secretion of mucus over the gill curtails the diffusion of oxygen (Neelima *et al*., 2016).

Decreased oxygen consumption was observed by Maharajan *et al.*, (2013) in *Catla catla* exposed to Profenofos, by Vakita Venkata Rathnamma and Nagaraju Bantu (2014) in *Labeo rohita* exposed to Chlorantraniliprole, by Jipsa *et al.*, (2014) in *Tilapia mossambica* exposed to Cypermethrin, by Anthony reddy (2015) in *Labeo rohita* exposed to Spinosad. Joshi and Kulkarni (2007) reported that *Garramullya* (Skyes) when exposed to Cypermethrin and Fenevelerate, oxygen consumption increased in the initial period in both lethal and sublethal concentrations and thereafter decreased. They concluded that alteration in oxygen consumption increased and later decreased which is a bioindicator for assessing the pesticide toxicity, which can be correlated with the present study.

From the above results and discussion, it can be concluded that decrease in oxygen consumption in fish in response to the toxic stress is the cumulative effect of several stages at which the toxicant act. From the results obtained, it is clearly evident that Cartap hydrochloride affect the oxygen consumption of *Cirrhinus mrigala* in all exposed concentrations.

CONCLUSION

In conclusion, the analysis of data from the present investigation demonstrated that Cartap hydrochloride had a profound impact on respiration in *Cirrhinus mrigala* in both sublethal and lethal concentrations. Variation in the oxygen consumption in Cartap hydrochloride exposed fish was probably due to impaired oxidative metabolism and pesticide induced stress. Changes in gill architecture under Cartap hydrochloride stress would alter the diffusing capacity of gill with consequent hypoxic or anoxic conditions thus, respiration may become a problematic task for the fish. These results suggest that the altered rates of respiration in *Cirrhinus mrigala* may also serve as a rapid biological monitor to assess the impact of pesticides such as Cartap hydrochloride on other biotic communities in the water body. This study also stresses the diligent use of pesticides to prevent environmental pollution.

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