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STUDY OF ACUTE TOXICITY OF BIS (TRIBUTYLTIN) OXIDE (TBTO) ON THE FRESHWATER FISH, *NEMACHEILUS BOTIA*, FROM NANDUR MADHMESHWAR DAM AT MAHARASHTRA, INDIA

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ABSTRACT
Acute toxicity of Bis (tributyltin) oxide (TBTO) has been studied on freshwater fish *Nemacheilus botia*. Static bioassays were performed on fresh water fish, *N. botia* to evaluate the median lethal concentrations of Bis (tributyltin) oxide (TBTO) for 24, 48, 72 and 96 hrs. The LC_{50} values were 0.01852, 0.0153, 0.01311 and 0.01099 ppm after 24, 48, 72 and 96 hours respectively. The results show that the LC_{50} values decreases with increase in exposure period.

INTRODUCTION

Pollution of aquatic ecosystem by chemical used in industry and agriculture is increasing day by day, heavy metals, pesticides, antifouling agents, fertilizers and agricultural drainage from water bodies adversely affects on growth and survival of aquatic animals.

Organotin compounds are highly versatile group of organometalics used in a number industrial and agricultural applications, including polyvinyl chloride stabilizers, catalysts, industrial and agricultural biocides, and wood-preserving and antifouling agents (Bock 1981; Jones *et al.,* 1982; Moore *et al.,* 1992). These chemical through surface runoff reaches to the unrestricted areas 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. The pollution of rivers and streams with chemical contaminants has become one of the most critical environmental problems of the century (Rane Minakshi and A. Y. Mahajan, 2013). In many countries large scale mortality of fishes have been recorded due to chemicals in water bodies as pollutants. The environmental destruction caused by anthropogenic factor lead to further destruction of aquatic fauna and especially the fishes (W. Vidyarani *et al.,* 2010) . Organotin compounds are readily incorporated into the tissues of filter feeding zooplanktons, grazing invertebrates and eventually higher organisms such as fish, water birds and mammals where it accumulates (Hussein K Okoro *et al.,* 2011).TBTO is xenobiotic Organotin compound that may affect the nervous system and alter behavior (Schweinfurth, 1985; Holm *et al.,* 1991; Fent and Meier, 1992; Triebskon *et al.,* 1994).

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. Nikam *et al.* (2011) carried out acute toxicity of organophosphate pesticide Metasystox on the freshwater fish, *Nemacheilus botia*. Several workers investigated the toxicity of Organotin compounds to aquatic animals (Rabbito *et al.,* 2005, Shejule *et al.,* 2006, Kharat P. S., 2007). Among the several aspects of toxicity studies, the bioassay constitutes one of the most commonly used methods in aquatic environmental studies with suitable organisms.

Perusal of literature reveals paucity of information on acute toxicity of TBTO on fresh water fish, *Nemacheilus botia*. Hence the present study has been focused to evaluate the acute toxic effects of TBTO on freshwater fish, *N. botia*, of local importance from Maharashtra state in Nandur Madhmeshwar Dam near Nashik.

MATERIALS AND METHODS

The fish *Nemacheilus botia* were netted from Nandur

Madhmeshwar Dam, 40 km east of Nashik in Niphad Taluka of Nashik District in Maharashtra State, India. The Nandur Madhmeshwar Lake is manmade reservoir constructed in 1911 at the junction of two rivers namely Godavari and Kadava on the coordinates of 19º59' to 20º4'N and 74º2' to 74º-10'E. The fishes were brought to laboratory and release in glass aquaria (size 0.909 X 0.303 X 0.303 m.), where a continuous and gentle flow of tap water was maintained. The fishes were fed on fishmeal procured from market and allowed to acclimatize to laboratory conditions for one week. Water was aerated twice a day to prevent hypoxic conditions. Pilot experiments were conducted to find out the range of the toxicity of the toxicant used TBTO. The chosen range of concentration was such that it resulted in 0 to 100% mortality. Stock solution (1ppm) was prepared in tap water (Laughlin *et al.,* 1983). The Series of statistic bioassay were conducted under laboratory condition as described by Finney (1964). Acute toxicity tests were conducted over 96 hours (h) and liters (L). The experimental troughs containing 2 liters (L) dechlorinated water were used to keep the animals. For each experiment ten fishes, *N. botia* of approximately same weight 1 ± 0.2 gram (g) and size 3 ± 1 cm were exposed to different concentrations of TBTO. After every 12 hours the polluted water was changed by the fresh solution of the same concentration without any disturbance of fishes. The mortality of the fishes was recorded before each change of water. The resulting mortality was noted in the range of 10 to 90% for each concentration for the duration of 24, 48, 72 and 96 h. Each experiment was repeated thrice to obtain constant results. The data collected was analyzed statically by means of probit method on transforming toxicity curve (% mortality vs. concentration), which allows the average median lethal concentration of Lc_{50} to be calculated for 24, 48, 72 and 96h. Dead fishes were counted individually.

RESULTS

The Lc_{50} values and exposure period showed a direct relationship. The Lc_{50} values, regression equations, Chi square, variance and 95% fiducial limits, lethal concentration and safe concentration are shown in Table 2. The Lc_{50} values obtained for TBTO exposed for 24, 48, 72 and 96 hours exposure were 0.01852, 0.0153, 0.01311 and 0.01099 ppm for 24, 48, 72 and 96 hours respectively. The result shows that Lc_{50} values decreases with increasing periods of exposure TBTO.

DISCUSSION

The percent survival rate of the fish decreased with increasing concentration and period of exposure. The evaluation of Lc_{50} concentration of pollutants is an important step before carrying out further studies on physiological changes in animals. The reaction and survival of aquatic organisms, under toxic conditions depend upon several factors such as kind, toxicity and concentration of the toxicant and the temperature, salinity, dissolved oxygen, PH, physiological factors such as reproductive cycle and seasons, in addition to the type and time of exposer to the toxicants (Holden, 1973; Brungs *et al.,* 1977)

In the present study the *N. botia* exposed to TBTO, the acute toxicity level was expressed in terms of Lc_{50} values. The LC_{50} values were found to be 0.01852, 0.0153, 0.01311 and 0.01099 ppm at 24, 48, 72 and 96 hours respectively.

TBT concentrations of acute toxicity were reported to range between 3 to 25.9 µg/L in some studied teleosts (Bushong *et al.,* 1988). According to Abdul Rahman *et al.* (2004) 24 h and 96 h Lc_{50} values of TBTO to Tilapia fish, *Oreochromis niloticus* were 31.5 and 16.33 µg/L respectively. Matthiessen (1974) measured a lethal threshold concentration of TBTO for *Tilapia mossambica* between 8 and 16 µg/L. Wester *et al.* (1990) reported no observed effect conc. of TBTO to small fish species *Oryzias latipes* (medaka) and *Poecilia reticulatl* (guppy) were 0.32 µg/L. Chliamovitch and Kuhn (1977) reported 24h and 96h Lc_{50} value of TBTO for rainbow trout (*Salmon gairdneri*) and Tilapia (*Tilapia rendelli*) were 30.8 and 53.2 µg/L respectively. Assem *et al.* (1999) found the 96h Lc_{50} value of TBTO for euryhaline red Tilapia (*Oreochromis* sp.) was 15.1 µ g/L

The sensitivity of different life stages of fish to TBTO may be varied. Larval stages are more sensitive to TBTO than adults. According to Thain (1983) the 48 h and 96 h Lc_{50} of TBTO to adult sole (*Solea solea*) were 88 and 36 µg/L whereas to the larval stage, they were 8.5 and 2.1 µg/L respectively. According to the ranking scheme for assessing the toxicity of chemicals to fish described by Hodson and Levi (1977), TBTO could be classified as extremely toxic to fish(24h $Lc_{50} < 1$ mg/L). In India TBT compounds have been used in antifouling paints and there is no ban on the usage of TBT in antifouling paints (Anita Garg *et al.,* 2011). The active substance TBT is highly toxic and showed damage to a multitude of non target species. J.T. Jagtap *et al.*, 2011 evaluated the median lethal concentrations of tributyltin chloride (TBTCl) for 24, 48, 72 and 96 hrs to bivalve, *Lamellidens marginalis* were 5.33, 4.02, 3.05 and 2.12 ppm respectively. Bruno Varella Motta da Costa et.al, 2014 reported the mean 24 and 48 h LC_{50} of TBT were 37 ± 9 and 36 ± 9 ìg L^{-1}, respectively. Bruno Varella Motta da Costa et.al, 2014 reported the mean 24 and 48 h LC_{50} of TBT to marine copepod *Tisbe biminiensis* were 37 ± 9 and 36 ± 9 µg L^{-1}, respectively.

Table 1: Relative toxicity of pesticide TBTO against the fresh water fish *N. botia*

Time of exposure (Hrs.)	Regression equation $Y = \bar{y} + (X - \bar{x})$	Lc_{50} Values in ppm	VarianceV	Chi-square	Fiducial limits		Lethal dose	Safe conc. (ppb)
					M_1	M_2		
24	Y= -9.8459x -17.3295	0.01852	3.1 X 10^{-4}	1.56719	2.3026	2.233	0.4445	0.003133
48	Y= -8.7281x-14.0681	0.0153	2.4 X 10^{-4}	0.57251	2.2152	2.154	0.7344	
72	Y= - 10.1359x - 16.465	0.01311	1.9 X 10^{-4}	1.63762	2.1447	2.091	0.9439	
96	Y= -6.5592x -8.3874	0.01099	3.9 X 10^{-4}	0.45249	-2.0797	-2.002	1.055	

The effect of TBTO on freshwater organisms is quite insufficient compare to marine organisms, so in the present work it is attempted to study the effect of TBTO on survival of freshwater fish, *N. botia*.

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