Determination of 96-Hr LC_{50} of Lead Nitrate for a Fish, Oreochromis niloticus

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Abstract

Metals are of special concern because of their diversified effects and the range of concentrations that could cause toxic ill-effects to the fish. Generally, heavy metals exert their toxic effects in organisms by generating reactive oxygen species, causing oxidative stress. This paper emphasizes on the determination of 96-hr LC_{50} value of Lead Nitrate for the fish, Oreochromis niloticus. The fish species were acclimatized in laboratory condition for 20 days. The stock solution of lead nitrate was prepared and fish were treated with different gradually increasing concentration of metals for 96 hours. The result showed that LC_{50} of Lead Nitrate for the fish, Oreochromis niloticus 44 mg/l. the mortality of the fish is directly proportional to the concentration of the expose metals.

Keywords: 96-Hr LC_{50}, Lead Nitrate, Oreochromis niloticus.

Introduction

Fishery resources are an important source of both macro- and micro-nutrients for humans. Internationally fish accounts for about 17 percent of animal protein ingestion show that fish is the most important animal-source food in the diets of more than one billion people\cite{1}. Due to feeding and living in the aquatic environments fish are particularly uncovered and heavily exposed to pollution because they cannot escape from the detrimental effects of heavy metals which affect water quality. Heavy metals are produced from a variety of natural and anthropogenic sources\cite{6}. In aquatic environments, heavy metal pollution results from nonstop atmospheric evidence, geologic weathering or through the discharge of agricultural, municipal, residential or industrial waste products, and also via wastewater treatment plants\cite{7,8}.

The many sources of water pollution cause difficult consequences to aquatic life. Fish and aquatic life those are at the top of the aquatic food chain are exposed to higher levels of toxins directly from the polluted water and by feeding on other fishes who are already exposed to high levels of toxins in water\cite{9,10}. Water pollution with heavy metals affects various physiological processes in fishes including breeding and development. The effects of waterborne metals on fishes are related to their uptake and accumulation by the organism, resulting in metal-induced disturbances in the structure and function of various tissues and organs\cite{11}.

Lead as a heavy metal is known to cause lethal effects on aquatic organisms. Oreochromis niloticus is a commercial fish and widely preferred as edible fish in Pakistan. It is very important to evaluate edible organisms like Oreochromis niloticus from toxicity point of view as health of human being is directly associated with it. During the present course of investigation acute toxicity tests of Lead Nitrate to determine 96-hr LC_{50} have been conducted on Oreochromis niloticus, a fish having high nutritional value as well as a it serves as a good pollution indicator.

Material and Methods

The present investigations were conducted at fish seed hatchery, Department of Fisheries and aquaculture, University of Veterinary and Animal Sciences, Ravi Campus. Individuals of Oreochromis niloticus were obtained from grow out ponds kept in holding tanks, supplied with flow through aerated water and acclimatized for 2 weeks, in the laboratory before...
conducted acute toxicity tests. Laboratory tests were conducted to determine the 96-hr LC50 and lethal concentrations of lead (Pb) for Oreochromis niloticus at constant temperature (30 °C) and pH (7.5) of water. Pure compound of Lead Pb (No3)2 was dissolved in deionized water and stock solutions (1000 ppm) were prepared. Acute toxicity tests were performed in glass aquaria attached with aeration system. Glass aquaria were filled with 80-liter metal free tap water and stock solution was added on metallic ion basis to get the desired concentration of metal. To avoid stress to the fish, the desired metal concentration in each aquarium was attained within 7 hours of the start of the experiment. Twenty individuals of experimental fish were tested against concentration of metal for the determination of both 96-hr LC50 and lethal concentrations. During acute toxicity trials, the fish were subjected to 12-hr photoperiod. The fish were not fed during acute toxicity trials. The concentration of Lead was started from zero up to the onset of 96-hr LC50 and lethal concentrations. The aquarium was examined after every 2 hours for fish mortality. The dead fish were weighed individually after being lightly blotted dry at the time of mortality observations and were dissected and their body organs viz. gills, liver, skin and muscle for the determination of their respective exposure metals by following the methods of S.M.E.W.W. (1989). For acute toxicity tests, the mortality data were statistically analyzed by using Probit Static Bioassay test system. The 96-hr LC50 and lethal concentrations were determined along against lead concentration for the determination of both 96-hr LC50. Twenty individuals of Oreochromis niloticus were tested against concentration of metal for the determination of both 96-hr LC50 and lethal concentrations at constant temperature (30 °C) and pH (7.50) of water. During the present investigation the 96-hr LC50 of Lead Nitrate for the fish, Oreochromis niloticus was found to be 44 mg/l (table.1). Similar results were also found by other researchers with different heavy metals for the same fish. The value of LC50 may vary in the same fish for the same heavy metals with different heavy metals for the same fish. The high level of total dissolved solids in the water resuantly causes hardness. This high hardness play to reduce the availability of Lead Nitrate to the fish. The susceptibility of Oreochromis niloticus to the toxic effect of Lead Nitrate is directly proportional to the concentration and duration of dose. If the dose increases the rate of mortality will also increase hence, confirms the observations made in Oreochromis niloticus by the effect of lead nitrate.

Table 1: Relation between concentration of Lead Nitrate and the percentage mortality of the fish

<table>
<thead>
<tr>
<th>Dose mg/l</th>
<th>Log of concentration</th>
<th>Total individuals</th>
<th>Mortality</th>
<th>Mortality %</th>
<th>Probit kill</th>
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<tbody>
<tr>
<td>0</td>
<td>-</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0.6020</td>
<td>20</td>
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<td>0</td>
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<td>0</td>
<td>0.06</td>
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<tr>
<td>12</td>
<td>1.0792</td>
<td>20</td>
<td>1</td>
<td>5</td>
<td>0.41</td>
</tr>
</tbody>
</table>

Fig 1: Regression line between the probit kill of Oreochromis niloticus and log concentration of Lead Nitrate

References
9. Kivi R. How Does Water Pollution Affect Fish? Available at (eHow.com) Sharma PD 2008. Weblog on Keeping World Environment Safer and Greener Oil Spills–adverse effects on marine environmental bio-system and control measures, 2010.


