The Determination of LC50 and Bioconcentration of Mercury Chloride (HgCl₂) in (Esox lucius)

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Abstract: Pike (Esox lucius) is one of the freshwater fish and is at the top level of food chain. The determination of the acute toxicity and bioaccumulation of mercuric chloride in pike Juveniles weighting 20±5 grams. The fish were exposed to various chemical concentrations in water. The tests were done in 20 liter tanks each containing 20 fish. We carried out six treatments with three replications and a control for each of the chemicals using the static O.E.C.D. method and investigate four days, through which the lethal concentrations (LC5096h) were studied. During the test physiochemical parameters of water The average pH was recorded as 8, total hardness 250 mg/lit, average water temperature was 25±1 degree centigrade and dissolved oxygen was 7.5±0.5 mg/lit. The result showed that LC5096h and LC5024h of mercury chloride (HgCl₂) on pike were 0.078 and 0.092 mg Hg/lit respectively. The bioaccumulation values during 24h in muscle tissue, kidney and gill were 1.93, 18.6 and 28.2 mg Hg/lit respectively. The exposures of the values during 96h were 3.8, 19.5 and 30.6 mg Hg/lit in tissue, kidney and gill respectively.

Key words: Pike (Esox lucius) • LC50 • HgCl₂ • Bioaccumulation

INTRODUCTION

Fish has been the main supply of cheap and healthy protein to a large percentage of the world's population. Fishes are a main protein of diet. They are particularly valuable for providing proteins of high quality comparable with those of meat, milk or eggs and are also a good source of n-3 fatty acids [1]. Effluents of agricultural and industrial processes contain highly toxic chemical like pesticides and heavy metals that lead to pollution of aquatic environments including rivers, ponds and lakes. The accumulation and persistence of metals and pesticides in the aquatic environment constitute a threat to biological life, as witnessed by the chronic and acute poisoning of fish and other aquatic organisms [2]. Beside good health benefits of fish, there were many reports on contamination of fish by chemical in the environment. The anthropogenic chemicals that have had the major impact on fishes to date are undoubtedly organochlorine compounds, including pesticides such as dieldrin and the DDT group and industrial materials such as the PCB and methyl mercury.

Toxicological effects of mercury have long been known. The effects described depend upon different parameters like dose and exposure route, but they include organ lesions (kidney, liver, lung), neurological effects and haematological alteration [3-5]. Immunological effects have also been described, both in mammals and in fish [6,7]. Among immunological effects in fish are alterations of intracellular calcium and tyrosine phosphorylation in leukocytes, decreased haematopoiesis were also shown to be affected by mercury [8]. Mercuric compounds are very toxic and the toxicity of mercury was known as early as the 16th century [9]. There are many reports indicating its genotoxic potential in a variety of organisms including humans and aquatic species [10].

Mercuric chloride has been used in agriculture as a fungicide, in medicine as a topical antiseptic and disinfectant and in chemistry as an intermediate in the production of other mercury compounds. The contamination of aquatic ecosystems by heavy metals has gained increasing attention in recent decades. The acute and chronic toxicity of heavy metals and
Fig. 1: South Caspian Sea, Sampling Area

pesticides to fish has been widely summarized [11]. Chronic exposure and accumulation of these chemicals by aquatic biota can result in tissue burdens that produce adverse effects not only in the exposed organisms, but also in organisms including human beings.

There are over 110 species fishes in the Caspian Sea. Fish are one of the important food compounds in the around the sea Esox lucius belongs to the family Esoxidea and order salmoniformes. The fish live in the marine, backish and freshwater and it is a predator and carnivores fish. The fish is one of the commercial fishes and there is in the people's diet who live near the sea. The fish is at the top level of food chain and it teeds the other fishes and crustaceans. There are a lot of sources around the Caspian sea that dump their wast in the rivers flowing in the sea. Mercury chloride is as water pollutants which exist in the waste of these sources, those without being controlled and filter are dumped in the rivers. Bioaccumulation in the higher levels of food chains in more effective than the lower levels and the fish in the Caspian sea is in the highest level. The present study was conducted to determine the acute toxicity of the heavy metal compound HgCl₂ and bioaccumulation in muscle tissue, kidney and gill in the fish.

MATERIALS AND METHODS

The impact of mercury chloride on the fingerlings of pike was studied in 2008. The fish were obtained from local commercial suppliers. Fish were transported to a glass aquarium in laboratory, which is equipped with a water cycling device, dechlorinated tap water, was used during the entire experiment. The determination of the acute toxicity and bioaccumulation of mercury chloride in pike juveniles weighting 25±5 grams.

Toxicity test methods for pike were based on the standard guide for conducting acute tests with fishes [12]. The tests were done in 20 liter tanks and 20 fish of similar size were randomly sampled. The fish were exposed to various chemical concentration in water.

We carried out six heatments with three replications and a control for each of the chemicals using the static O.E.C.D method and investigate four days, through which the lethal concentration (LC50 96 h) were studied.

During the test physiochemical parameters of water such as, pH, dissolved Oxygen, total hardness and temperature were measured. During the experiment, deat fish were removed and the mortality was recorded after 24, 48, 72 and 96 h. the LC50 of mercury chloride and its 95% confidence limits for pike were calculated using a basic program from the probit analysis described by Finney [13]. Fish were respectively exposed to a test solution of the mercury chloride.

After four days the fish for measuring of bioaccumulation sampled. Mercury chloride measured in the muscle tissue, kidney and gill with mercury Analyzer (Model: LECO AMA254).

All values of the tests were statistically analyzed by analysis of variance (ANOVA) using SPSS statistical software.

RESULTS AND DISCUSSION

Physicochemical factors (temperature, pH, total hardness and Do) were measured throughout each experiment and their results showed in Table 1. All physicochemical parameters remained relatively constant throughout the experimental period median lethal concentration (LC50) of mercury chloride for pike Juvinias were obtained. Values for the 24, 48, 72, 96 h LC50 are presented in Table 2.
It is clear from Fig. 2 that as the concentration of the chemical increased, fish mortality also increased, which indicates a direct proportional relationship between mortality and concentration of test chemical.

Mean values of bioaccumulation in the three organs (muscle tissue, kidney and gill) showed in Table 3, after 24 and 96 h.

Although heavy metals are often referred to as a common group of pollutants, each metal produces different problems in freshwater environments and therefore metals have to be considered separately as well as in various combinations [14]. Because many wastewater discharges contain a mixture of pollutants, zinc, aluminum and mercury have to be evaluated. Abnormal behavior for fishes exposed to HgCl₂ had several reported [15]. Comparing the toxicity of HgCl₂ with those of other metals studied such as copper (96-h LC₅₀ 0.64 mg/l) and cadmium (96h LC₅₀ 2.15 mg/l) for the same species [16].

Physicochemical parameters are effective on toxic of heavy metals. Rathore and Khangarot [17] reported that the acute toxicity of HgCl₂ increases with increase in for other metals. Khangarot [18] reported tremendous variation in LC₅₀ values for zinc at lower and higher temperature. The increased sensitivity to heavy metals at higher temperature might be the result of increased metabolic activity, respiratory and cardiac rates, coupled with temperature potentiation of metal ion action on cellular enzymes and cell membrane.

Feeding habit is important because it may represent the basis for accumulation of mercury in fishes. Muscle tissue of predatory fishes contained significantly higher content of total mercury than muscle tissue of nonpredatory fishes. In the other predator fishes total mercury concentrations were high. In the muscle tissue
of long tail tuna (0.5±0.7) and mackerel (0.45±0.56). The lowest content of total mercury were found in the muscle tissue of sardine (0.00±0.02), whose diet consists mainly of water plants and planktons (Isa et al., 1998). Many researchers have shown that the mercury concentration in liver is higher than muscle tissue [19].

In the our study mercury concentrations in the gill was haghr than kimey, in the kidney was higher than muscle tissue but bioconcentration values for organs of the fish were higher than the ones in water.

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REFERENCES