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Effects of Heavy Metals (Copper and Cadmium) and Detergent (LAS) on White Fish Fry *Rutilus frisii* Kutum

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Abstract: In this survey, the individual and mixed effects of heavy metals such as copper and cadmium and detergent (LAS) on 1 g white fish Fry (*Rutilus frisii* Kutum) were studied with 6 treatments and one blank in 3 replications using OECD method in the laboratory and concentration limits were determined with logarithmic method for Cadmium (0.1-0.5), copper (1-5) and LAS (10-19) mg L^{-1}. Finally, the achieved results were calculated with Probit analysis and Correlation coefficient was regarded for Cadmium 0.93, copper 0.92 and LAS 0.98 and in mixture of Cadmium and LAS 0.93 and mixture of copper and LAS 0.98. The amounts of LC_{10}, LC_{50} and LC_{90} and permissible limits of above mentioned pollutants were calculated too. Copper effect on white fish fry caused LC_{10} = 1.83, LC_{50} = 4.02, LC_{90} = 8.79 Cadmium effect caused LC_{10} = 0.11, LC_{50} = 0.21, LC_{90} = 0.34; LAS caused LC_{10} = 5.91, LC_{50} = 11.62, LC_{90} = 22.71; mixture of LAS and Cadmium caused LC_{10} = 0.017, LC_{50} = 0.047, LC_{90} = 0.12; mixture of LAS and copper caused LC_{10} = 0.02, LC_{50} = 0.09, LC_{90} = 0.37. Hierarchically, the amounts of pollutants permissible limits for Cadmium effect on white fish fry were 0.021, for copper 0.4, for LAS 1.16 and mixture of Cadmium and LAS 0.004 and mixture of LAS and copper 0.009.

Key words: White fish, permissible limits, detergent, heavy metal

INTRODUCTION

Expansion of pollutants in the environment and human dependency upon the environment to supply nutrition and other requirements, are of great importance in the assessment of different pollutants especially for waters and other aquatics (Mullick and Konar, 1991).

Entering industrial sewage, different petrochemical industries, oozing out the oil and gas and entering the heavy metals and detergents are of great danger (Tizkar, 1998).

Since, discharging various civil, Industrial and agricultural Sewage to other aquatic Sources is done without any limitation and control, the pollution of rivers and marshlands are of significant and serious matters in our country. Nowadays, migration of white fish has been reduced because of excessive pollution of Anzali lagoon and its rivers all around in guilan province (Tizkar, 1998). Heavy metals such as Cu and Cd, which exist in the environment, are absorbed with algae. According to the observations done for the algae, they naturally have more places to join the metals and the representative of the presence of such metals in invertebrates and finally fishes will be defined by food chain (Ghasemalavi, 2003).

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Stouthart *et al.* (1996) showed the absorbance of copper after carp hatching in pH = 6.3 is 2 times more than in pH = 7.6. In pH = 6.3, all the larvae exposed to copper, are not able to fill their swim bladder and Yolk bladder is not able to be absorbed. Considering the above-mentioned subjects, the assessment of individual and mixed effect of heavy metals and detergents on 1 g white fish fry, which is of important and economical fish in the Caspian sea and dependency of its larvae on marshland nutrition is regarded as an important matter.

Therefore, we try to enhance the survival of Frisian white fish fry and larva through more study on sewage filteration in rivers and marsh land flows to the sea.

MATERIALS AND METHODS

Our researcher harvested some of white fish (*Rutilus frisii* Kutum) that they are local fish of guilan province, in 2007-2008 and put them in similar of temperature in some aquarium.

The tests were done with OECD (1984) method and the intensive toxicity on two heavy metals, copper and cadmium as well as the detergent (LAS) was assessed individually and mixedly on 1 g white fishes fry. The Tests were done statically. The Tests for deter mining the intensive toxicity were done in 96 h and physical and chemical factors such as temperature, oxygen, pH, hardness and EC were measured, too.

The heavy metals and the detergent solution concentration will be reached to 1 g L^{-1} with distilled water. The tested concentrations will be divided into 6 treatment and one blank by logarithmic measurements and a theoretical limit. After determination of effective concentration with 3 replications, City dechlorated water will be added to lo lifer aquariums. In aquarium, 10 fries will be released. Each 24 h, the mortality of fries will be recorded and Fries behaviors in mortality test assessment will be registered. At the and of each 96 h, the percentage of mortality in each test according to LC_{10}, LC_{50}, LC_{90} and also permissible limit of mixed and individual pollutants effect on fries were calculated and compared to each other. The entire data was analysed with perobit analysis statistic method (Finny, 1971). In order to determine the differences between treatments caused of individual and mixed effect of pollutants on white fish Fry, kroscal Valis nonparameter Test and dankan average comparison test were done on the assuring level of 95%.

RESULTS

The effective cadmium concentration on white fish fry was tested and was determined 0.1-0.5 mg L^{-1}. Then, Concentration limits were divided into various treatments and Final tests were done. According to achieved results it was shown that the minimum concentration of cadmium chloride which causes the least effect on white fish fry is 0.021 mg L^{-1} (Table 1). Considering such results, regression line slop was calculated and LC_{10}, LC_{50}, LC_{90} were determined for cadmium (Table 1).

The effective concentration of copper was determined 1-5 mg L^{-1} (Table 1). The results showed that the minimum concentration of copper which causes the least effect on white fish fry is 0.4 mg L^{-1}.

The effective concentration of detergent (LAS) on white fish fry was tested and determined 10-19 mg L^{-1} (Table 1). The minimum effect which causes the least effect on fry is 1.162 mg L^{-1}.

The effective concentration of detergent (LAS) and cadmium mixture based on individual cadmium and detergent LC_{50} were 0.021-0.39 for cadmium and 11.16-22.71 mg L^{-1} for LAS (Table 1) considering the results, the minimum effect of cadmium chloride and LAS mixture which causes the least effect on the fry, is 0.004 mg L^{-1}.

Table 1: The experimental obtained of heavy metals (Cu and Cd) and detergent (LAS) effect of individual and mixture in white fish fry (1g) (*Rutilus frisii* Kutum)

Kind of pollutant	Concentration range to witness in white fish fry (1 g) (*Rutilus frisii* Kutum) (ppm)	Linear equation of regression in 96 h y = ax+b	Correlation coefficient (r)%	Lethal concentration (mg L^{-1}) in 96 h		
				LC_{10}	LC_{50}	LC_{90}
Cd	0.1-0.5	y = 4.8507x+8.2498	70	0.11	0.21	0.39
Cu	1-5	y = 2.7791x+2.7226	92	1.83	4.02	8.79
LAS	10-19	y = 4.3982x+0.3148	83	5.91	11.62	22.71
LAS+Cu	0.4-8.79, 1.16-22.71	y = 2.1981x+7.2222	87	0.02	0.09	0.37
LAS+Cd	0.21-0.39, 1.16-22.71	y = 3.0341x+9.003	91	0.017	0.047	0.12

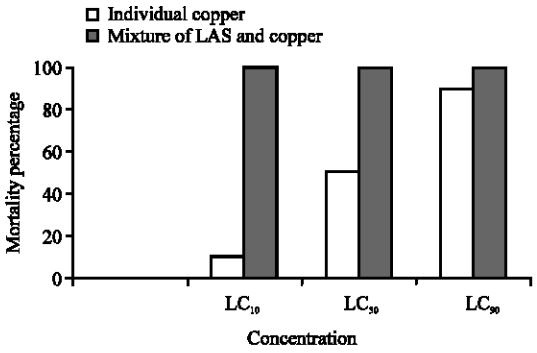

Fig. 1: Mortality percentage of 1 g white fish fry considering the concentration of mixture of copper and LAS with individual copper during 96 h

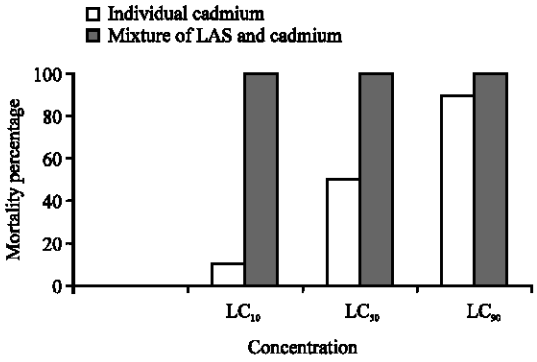

Fig. 2: Mortality percentage of 1 g white fish fry considering the mixture of cadmium and LAS with individual cadmium during 96 h

Based on calculated LC of individual pollutants, the effective concentration of copper and LAS mixture is 0.4 for copper and 1.16-22.71 mg L^{-1} for LAS (Table 1). The results show that the minimum concentration of copper sulphate and LAS mixture which Causes the least effect on the fry, is 0.009 mg L^{-1}.

Comparing to individual effect of heavy metal, copper, on the fry, the mortality percentage in white fish fry increased to 100% based on LC (10-50-90) (Fig. 1). Such increase was seen for the mixture of cadmium and LAS, comparing to individual effect of cadmium on the fry based on LC (10-50-90) (Fig. 2). *Organization for Economic Cooperation and Development.

DISCUSSION

The results of the assessments show the individual and mixed affect of heavy metals, such as copper and cadmium and detergents LAS on the fry. The concentration of cadmium which causes 50% reduction in the fries population is 0.21 mg L^{-1}. The permissible limit of such pollutant is 0.021 mg L^{-1}. Wright (1995) showed that the cadmium absorption is done through the gills. The absorption and toxicity of cadmium in calcium-free water is more than hard water. Calcium balances these effects. The amount of calcium reduces in rainbow trout roe contacting cadmium for 6 h (Zamini, 1996). In tests done based on the effect of cadmium on Amur fish and Phytophage, the mortal concentration limit in carp, is between 1-5 mg L^{-1}. Rand (1995) announced that permissible limit of cadmium in fresh water fish is 0.05 mg L^{-1}. This amount is equal to what achieved in previous researches, so it proves the accuracy of the tests. The results of the assessments; show the effect of copper on white fish fry. The concentration of copper which causes 50% reduction in white fish fry population is 4.02 mg L^{-1} and permissible limit of such pollutant is 0.4 mg L^{-1}. Stouthart *et al.* (1996) declared in his assessments that carp roes which face to the concentrations of 0.3-0.8 mg L^{-1} in pH = 6.3-7.6, cause mortality, spinal cord deformation and disturbance in heart pulses. The absorbance of copper after carp hatching in pH = 6.3 is 2 times more than in pH = 7.6. In pH = 6.3, all the larvae exposed to copper, are not able to fill their swim bladder and Yolk bladder is not able to be absorbed. Shapoori (2001) determined copper toxicity limit 1-5 mg L^{-1} in her assessments of the copper effect on muscle's tissues, Gonads and liver changes in carp.

Rand (1995) claimed that the amount of LC_{50} in the effect of copper on fresh water fish is between 0.01-0.02. Considering the achieved results, this study shows that the amount of LC_{50} in the effect of copper of white fish fry is exactly in the same limit as Rand declared in his studies.

The results of the assessments about the effect of the detergent (LAS) on white fish fry show that the concentration which causes 50%. Reduction in fry population, is 11.62 mg L^{-1} and the permissible limit of such pollutant is 1.162 mg L^{-1}. Tomoregie anc Okwuosa (2005) determined the intensive toxicity of LAS on onchorhynchus mykiss by using static bioassessment method in 96 h LC_{50} is 8.6-25.11 mg L^{-1}.

Tehrani (2000) declared that the amount of LC_{50} of linear Anionic detergents on Finger-ling white fish is 12.2 mg L^{-1}. Rand (1995) also claimed that LAS mortal concentration permissible limit in 96 h for fresh water fish is 0.1-0.5 mg L^{-1} which amounts to the achieved results in such study.

The results of the assessments show the effect of the mixture of the detergent (LAS) and cadmium and also the mixture of LAS and copper on white fish fry.

The concentration of the mixture of LAS and cadmium which causes the 50% reduction in fry population is 0.047 mg L^{-1} and the permissible limit is 0.004. These numbers are 0.09 and 0.009 mg L^{-1} for the mixture of LAS and copper.

Madhyasta and Nayak (1984) declared that the effect of the mixture of LAS and D.D.T on Rasbora daniconius during 29 days can cause hematological changes such as reduction in the number of blood red cells and increase in all blood white cells.

Chattopadhyay and Konar (1991) found that whenever the detergents mix with other chemicals, the mortality percentage in creases. In the assessment of the effect of the Anionic detergents mixture with (N-heptan, LAS 20%) parnol.j on *Diaptomus forbesi*, it was

concluded that the mortality increased from 10 to 50%. The detergent breaks the plasma proteins membranes and causer the entrance of other pollutants such as heavy metals in to the cell.

Drewa and Chesy (2001) assessed the morphological changes of liver cells in *Gasterosteus aculeatus* which were exposed to the mixture of oil pollutants and Anionic detergents and they declared that the mortality percentage in creases from 50% for individual effect of the pollutants to 80% for mixed effect of pollutants.

The results of the effect of the pollutants effect on white fish fry showed that the mixture of heavy metals with detergents has more percentage of mortality than the individual effect of heavy metals. Considering LC_{10}, LC_{50}, LC_{90}, the individual effect of copper and cadmium and LAS on white fish fry increaser to 100% comparing with the mixture of copper and LAS and LAS and cadmium.

Considering the Kroskal Valis non-parametric test with assuring level of 95%, it's concluded that there is a statistic difference between the effect of copper-cadmium and LAS on white fish fry ($p<0.05$). In assuring level of 99%, there is no statistic difference ($p<0.01$). There is a statistic difference between copper and LAS-copper ($p<0.05$) but there is no statistic difference between copper and LAS- copper in assuring level of 99% ($p>0.01$). There is no statistic difference between cadmium and cadmium-LAS.

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