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Full Length Research Paper

Effect of hypochlorite sodium as an agent detergent on mortality response of fishes

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The acute toxicity of hypochlorite sodium to four species of freshwater fishes was investigated in laboratory tests. All fishes were exposed to hypochlorite sodium at several selected concentrations and number of mortality was registered after 24, 48, 72 and 96 h. LC50 values were determined with probite analysis. According to the results LC50 96 h hypochlorite sodium were 42.9 ± 0.20, 33.2 ± 0.36, 22.7 ± 0.22, 41.7 ± 0.19 for common carp, silver carp, roach and gold fish respectively. According to the results procure in the present experiment; hypochlorite sodium had more toxicity to roach compared to silver carp, common carp and gold fish.

Key words: Hypochlorite sodium, mortality, acute toxicity, freshwater, LC50.

INTRODUCTION

Introduce of pollutants from industrial activities to other aquatic ecosystems can also disturb the existing balance in the ecosystem, and it will be the threat for aquatic organisms. Hypochlorite sodium is current domestic output for the cleaning of household bodies. The detrimental effects of hypochlorite sodium for aquatic organisms are related to biodegradability and wastage behavior (Herbert et al., 1957; Swisher, 1970) and innumerable environmental and biological agents (Marchetti, et al., 1965). Sensitivity of different fish species to toxic substances is variable hence, toxicology tests are necessary for various fish (Barak and Mason, 1990). The objective of present research was to estimate acute toxicity of hypochlorite sodium on survival response of these fishes. The LC_{50} tests are conducted to measure the survival potential of fishes to particular toxic substances (Hedayati et al., 2010b). Toxic substances can sometimes be lethal or semi-lethal (Mason, 1991; Stanley, 1992). Sub lethal concentrations of toxicant may affect on the behavior of organisms and fitness of a natural population (Grobler et al., 1989; Wepener et al., 1992). The aim of this study is to survey acute effect of the pollutant hypochlorite sodium on mortality of some freshwater fish.

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MATERIALS AND METHODS

In this research some valuable freshwater fish: Silver Carp (*Hypophthalmicthys molitrix*), common carp (*Cyprinus carpio*), gold fish (*Carassius auratus*) and roach (*Rutilus rutilus*) to determine acute toxicity effects of hypochlorite sodium. Tested fishes were transferred to a 400-L tank equipped with aeration having 200 L of test medium. During the test the physicochemical conditions of water are kept constant (Di Giulio and Hinton, 2008). Fishes were investigated using static bioassays after keeping them under continuous aeration over a period of 96 h.

Tested fishes were fed daily with a formulated feed. All the 4 groups of juvenile fishes were treated with 4 different concentrations of hypochlorite sodium for 96 h. Test medium was not renewed during the assay and feeding was stopped. The mortality count was recorded every 24 h and dead fishes were removed to avoid possible decadence of the water quality (Gooley et al., 2000). Acute median lethal concentration (LC50) and their 95% confidence limits for all tests obtained by Finney's method were calculated with the formula of Mohapatra and Rengarajan (1995). LC50 values of 24,

Table 1. Cumulative mortality of common carp during acute exposure to hypochlorite sodium (n=21, each concentration).

Concentration (ppm)	Number of mortality			
	24 h	48 h	72 h	96 h
Control	0	0	0	0
0.20	0	0	0	0
1.00	0	0	0	0
2.00	0	0	0	0
5.00	0	0	0	0
10.00	0	0	0	0
20.00	0	0	0	0
30.00	0	0	0	0
50.00	4	14	16	18
100.00	15	18	21	21

Table 2. Cumulative mortality of Silver carp during acute exposure to hypochlorite sodium (n=21, each concentration).

Concentration (ppm)	Number of mortality			
	24 h	48 h	72 h	96 h
Control	0	0	0	0
0.20	0	0	0	0
1.00	0	0	0	0
2.00	0	0	0	0
5.00	0	0	0	0
10.00	0	0	0	0
20.00	0	0	0	0
30.00	0	0	2	6
50.00	9	13	16	21
100.00	16	17	21	21

48, 72 and 96 h were determined using Finney's (1971) method of ''probit analysis'' and with SPSS computer statistical software. The mean lethal concentration LC50 (concentration of hypochlorite sodium at which 50% mortality of test population occurred) for an exposure period of 24, 48, 72 and 96 h was designated by trial and error. Amounts of LC1, LC10, LC30, LC50, LC70, LC90, LC99 was calculated using probit tables, mortality and probit regression.

Finally the maximum toxicant concentration (MATC) was evaluated for the trial with the lowest NOEC and LOEC (Hedayati et al., 2011).

RESULTS

The mortality of tested fishes for different doses of hypochlorite sodium was examined during the exposure times at 24, 48, 72 and 96 h (Tables 1 to 4).

There were significant differences in number of dead fish between the duration 24 to 96 for each fish variety.

Tests for conducted for 96 h in order to evaluate the sensitivity of fishes, short-term effects of hypochlorite sodium and to determine the median lethal concentration of LC50.

The mortality of these fishes for hypochlorite sodium doses were registered during the exposure times at 24, 48, 72 and 96 h (Tables 1 to 4).

The number of dead fishes had been increased significantly ($p<0.05$) with increasing concentration. Finally, based on tests done and statistical methods Probit program the $LC_{1,10,30,50,70,90,99}$ values hypochlorite sodium were measured at time 0, 24, 48, 72 and 96 h (Tables 5 to 8).

The LC_{50} 96h values are between for 20 to 40 (ppm) concentrations for all fishes except of roach. Median lethal concentrations of 1, 10, 30,50,70,90 and 99% test are in Tables 5 to 8. The LC_{50} 96h values of hypochlorite sodium for common carp, silver carp, roach and gold fish were 42.9 ± 0.20, 33.2 ± 0.36, 22.7 ± 0.22, 41.7 ± 0.19.

Table 3. Cumulative mortality of roach during acute exposure to hypochlorite sodium (n=21, each concentration).

Concentration (ppm)	Number of mortality			
	24 h	48 h	72 h	96 h
Control	0	0	0	0
0.20	0	0	0	0
1.00	0	0	0	0
2.00	0	0	0	0
5.00	0	0	0	0
10.00	0	0	0	0
20.00	0	0	0	4
30.00	16	19	21	21
50.00	19	21	21	21
100.00	21	21	21	21

Table 4. Cumulative mortality of gold fish during acute exposure to hypochlorite sodium (n=21, each concentration).

Concentration (ppm)	Number of mortality			
	24 h	48 h	72 h	96 h
Control	0	0	0	0
0.20	0	0	0	0
1.00	0	0	0	0
2.00	0	0	0	0
5.00	0	0	0	0
10.00	0	0	0	0
20.00	0	0	0	0
30.00	0	0	0	0
50.00	7	12	18	19
100.00	15	15	21	21

Table 5. Lethal concentrations (LC1-99) of hypochlorite sodium (mean ± Standard Error) depending on time (24 to 96 h) for common carp.

Point	Concentration (ppm) (95 % of confidence limits)			
	24 h	48 h	72 h	96 h
LC_1	21.7 ± 0.45	7.6 ± 0.31	30.8 ± 0.25	29.6 ± 0.20
LC_{10}	49.0 ± 0.45	31.6 ± 0.31	37.1 ± 0.25	35.6 ± 0.20
LC_{30}	68.7± 0.45	49.0 ± 0.31	41.7 ± 0.25	39.9 ± 0.20
LC_{50}	82.4 ± 0.45	61.0 ± 0.31	44.9 ± 0.25	42.9 ± 0.20
LC_{70}	96.1 ± 0.45	73.1 ± 0.31	48.1 ± 0.25	45.9 ± 0.20
LC_{90}	115.9 ± 0.45	90.5 ± 0.31	52.7 ± 0.25	50.2 ± 0.20
LC_{99}	143.2 ± 0.45	114.4 ± 0.31	59.0 ± 0.25	56.2 ± 0.20

DISCUSSION

Pollution prevents the growth of aquatic organisms by disrupting the metabolic processes. Laboratory studies indicate the potential toxins in the aquatic environment are very high. Data and information's from toxicology tests represents the effects of these toxins by the freshwater fish population in science ecotoxicology (Francisco et al., 1994). The results show that hypochlorite sodium is more toxic to roach. The results obtained from this investigation showed that the percentage mortality of these fishes increased

Tabe 6. Lethal concentrations (LC1-99) of hypochlorite sodium (mean ± standard error) depending on time (24 to 96 h) for silver carp.

Point	Concentration (ppm) (95 % of confidence limits)			
	24 h	48 h	72 h	96 h
LC_1	10.9 ± 0.33	6.9 ± 0.29	21.3 ± 0.91	22.3 ± 0.36
LC_{10}	38.7 ± 0.33	33.0 ± 0.29	31.1 ± 0.91	27.2 ± 0.36
LC_{30}	58.8 ± 0.33	51.9 ± 0.29	38.2 ± 0.91	30.8 ± 0.36
LC_{50}	72.7 ± 0.33	65.0 ± 0.29	43.1 ± 0.91	33.2 ± 0.36
LC_{70}	86.7 ± 0.33	78.2 ± 0.29	48.0 ± 0.91	35.7 ± 0.36
LC_{90}	106.8 ± 0.33	97.1 ± 0.29	55.1 ± 0.91	39.3 ± 0.36
LC_{99}	134.6 ±0.33	123.2 ± 0.29	64.9 ± 0.91	44.2 ± 0.36

Table 7. Lethal concentrations (LC1-99) of hypochlorite sodium (mean ± standard error) depending on time (24 to 96 h) for roach.

Point	Concentration (ppm)		(95% of confidence limits)	
	24 h	48 h	72 h	96 h
LC_1	8.8 ± 0.49	18.4 ± 0.18	17.6 ± 0.17	15.9 ± 0.22
LC_{10}	18.7 ± 0.49	21.8 ± 0.18	20.9 ± 0.17	19.0 ± 0.22
LC_{30}	25.8 ± 0.49	24.3 ± 0.18	23.2 ± 0.17	21.2 ± 0.22
LC_{50}	30.8 ± 0.49	26.0 ± 0.18	24.8 ± 0.17	22.7 ± 0.22
LC_{70}	35.7 ± 0.49	27.7 ± 0.18	26.5± 0.17	24.2 ± 0.22
LC_{90}	42.9 ± 0.49	30.2 ± 0.18	28.8 ± 0.17	26.4 ± 0.22
LC_{99}	52.8 ± 0.49	33.6 ± 0.18	32.1 ± 0.17	29.4 ± 0.22

Table 8. Lethal concentrations (LC1-99) of hypochlorite sodium (mean ± standard error) depending on time (24 to 96 h) for gold fish.

Point	Concentration (ppm)		95% of confidence limits	
	24 h	48 h	72 h	96 h
LC_1	13.6 ±0.35	5.45 ± 0.28	29.6 ± 0.20	29.0 ± 0.19
LC_{10}	42.6 ± 0.35	35.1 ± 0.28	35.6 ± 0.20	34.7 ± 0.19
LC_{30}	63.5 ± 0.35	56.6 ± 0.28	39.9 ± 0.20	38.9 ± 0.19
LC_{50}	78.1 ± 0.35	71.4 ± 0.28	42.9 ± 0.20	41.7 ± 0.19
LC_{70}	92.6 ± 0.35	86.3 ± 0.28	45.9 ± 0.20	44.6 ± 0.19
LC_{90}	113.6 ± 0.35	107.8 ± 0.28	50.2 ± 0.20	48.8 ± 0.19
LC_{99}	142.5 ± 0.35	137.5 ± 0.28	56.2 ± 0.20	54 5 ± 0.19

significantly ($P<0.05$) with increase in the concentrations of linear hypochlorite sodium.

Probit analysis revealed that the LC50 values decreased as the concentration of the chemicals increased, indicating an increase in toxicity with increased concentrations.

The death of species of freshwater fishes may be injurious, as it could result in depletion of viable organisms that contribute to the food chain. The results obtained in the tests indicate that standardization of the toxicity of materials should be performed. According to the organisms and median used; not doing so may lead to inaccurate assessments about the toxic effects of chemicals on organisms (Ogeleka et al., 2011).

However, the government must not only enact laws to dump waste, but must comply with these regulations through the implementation of wastewater treatment in industry before entering the ecosystem health of the environment guarantee (Ayandiran et al., 2010).

Conclusion

The aim of this study is to survey acute effect of the

pollutant hypochlorite sodium on mortality of some freshwater fish. In summary, according to the results procure in the present experiment, hypochlorite sodium had more toxicity to roach compared to silver carp, common carp and gold fish, and its toxicity varied with increase of concentration and exposure time. Additionally, roach fish was sensitive to low values of hypochlorite sodium.

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