Evaluation of Toxicity of Bleaching Agents on Tilapia Fish

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ABSTRACT

Bleaching agent is used in various industries to lighten a substance. They are majorly used in textile processing, paper whitening, and pulp bleaching as well as for home laundering. Effluents from textile industries contain different bleaching agents and these are directly released into water bodies. They in turn show adverse effect on the ecosystem and cause damage to the fish in general. Present study was done to evaluate the LC_{50} for Sodium Percarbonate, Sodium Hypochlorite and Sodium Hydrosulphite at different concentration ranging from -10mg/lit to 50 mg/lit on fresh water fish Tilapia Mozambique. The lethal concentration was in the order- Sodium Hydrosulphite > Sodium Per carbonate > Sodium Hypochlorite. These agents also affected the behavioral pattern of the fish.

Keywords: LC_{50}, Bleaching agent, Sodium Percarbonate, Sodium hypochlorite, Sodium Hydrosulphite, Tilapia.

INTRODUCTION

Textile and clothing industry globally is one of the largest and oldest industries of economic importance (*Gereffi, 2002*). In the textile industry the final product is obtained after a series of procedures which includes; sizing, desizing, scouring, bleaching, mercerizing, dyeing and printing (*Dey and Islam, 2015; Saini, 2017*).During this processes large amount of wastewater is generated which are generally released as effluents in the nearby water bodies, and acts as sink for toxic chemicals (*Karthikeyan et al., 2006; Adewoye et al., 2005; Roopadevi and Somashekar, 2012*). They are of major causes of concern due to their toxicity, persistency and accumulation both in environment and the flora and fauna (*Nabi Bidhendi et al. 2007, Vinodhini et al., 2009*).

Fish act as bioindicators as they are highly sensitive to changes in the aquatic environment (*Siroka & Drastichova, 2004*). Pollutants cause behavioral changes in fishes (Little and Finger, 1990; Michael . Barry, 2012) and release of effluents can also results in mass mortality of fishes (Das, 2003).

LC_{50} is the concentration of a substance that is lethal to 50 percent of the organisms in a toxicity test. 96h LC_{50} tests is conducted to measure the susceptibility and survival potential of organisms to a particular toxicant (Sadat Sadeghi and Peery, 2018). The present study aims to investigate the LC_{50} of bleaching agents Sodium Percarbonate, Sodium Hypochlorite, Sodium Hydrosulphite on Tilapia fish and also study changes in behavior pattern.

MATERIALS AND METHODS

Fish Collection and Acclimatization

Tilapia Mozambique irrespective of sex but of similar size was procured from Fish Seed Hatchery, Aarey colony Mumbai, Maharashtra. Fishes were acclimatized in the laboratory in dechlorinated water for a week prior to experiments. Acclimatization was done at 25 ± 2^{o}C under a constant 12:12h light: dark photoperiod. Acclimatized fish were fed with commercial diet twice a day.

Experimental Design

Bleaching agents, Sodium Per carbonate, Sodium Hypochlorite and Sodium Hydrosulphite of analytical grade were used for preparation of stock solutions. Fishes were exposed separately to different concentrations (Ranging from 10mg/lit to 50

mg/lit at increments of 5mg/l) of bleaching agents. Experiment was done by grouping 14 fish and exposed to 96h in glass tanks. Test medium was not renewed during the assay period and no food was given. Mortality was recorded at 24, 48, 72 and 96h of exposure and dead fish were removed immediately from the test media.

STATISTICAL ANALYSIS

Finney's method of probit analysis was used to calculatethe 96-hr LC_{50} with SPSS Statistical Software.

RESULTS AND DISCUSSION

Physical and behavioral changes during the study period are shown in Figure 1. Pollutants can lead to change in schooling behavior, cause hyperactivity resulting in erratic swimming, seizures and loss of buoyancy in fishes (Madhu,2019).Significant change was seen in the experimental fishes exposed to higher concentrations of bleaching agent. They showed discomfort within few minutes of exposure, which included erratic swimming, rapid movement, loss of equilibrium with increased opercular movement and change in body color when compared to control (Figure1). Change of behavior in C.carpio was also reported when exposed to mercury chloride (Masudet al', 2005).Body was slimy due to mucus secretion from the epithelium of gills when fishes were exposed to bleaching agents. Similar results was observed in C.carpio when they were exposed to pesticide chlorpyriphos (Hallap and David, 2009).

Figure 1. Photographs showing physical and behavioral changes- (A) Loss of equilibrium. (B) Change in body colour. (C)Increased opercular movement

The LC_{50} value for Sodium Percarbonate, Sodium Hypochlorite and Sodium Hydrosulphite was calculated using Finney's method of probit analysis and SPSS Statistical Software at 96 hours of exposure time and is shown in Table 2 (A,B,C).

Table 2: (A) LC50 value of Tilapia Mozambique exposed to different concentrations of Sodium Percarbonate for 96 hours

Sr. No.	Concentration of SodiumPercarbonate (mg/l)	No. ofFishes Exposed	No. of Fishes died at 96hr	log concentration	Probit Kill%	Percentage mortality
1	05	14	0	0.69897	0	0
2	10	14	0	1	0	0
3	15	14	2	1.176091	3.92	14
4	20	14	2	1.30103	3.92	14
5	25	14	5	1.39794	4.04	36%
6	30	14	6	1.477121	4.8	43
7	35	14	6	1.544068	4.8	43
8	40	14	7	1.60206	5	50
9	45	14	10	1.653213	5.55	71
10	50	14	14	1.69897	8.09	100

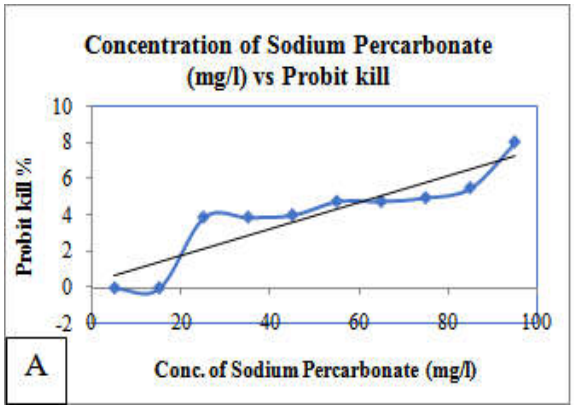
Table 2: (B) LC50 value of Tilapia Mozambique exposed to different concentrations of Sodium Hypochlorite for 96 hours

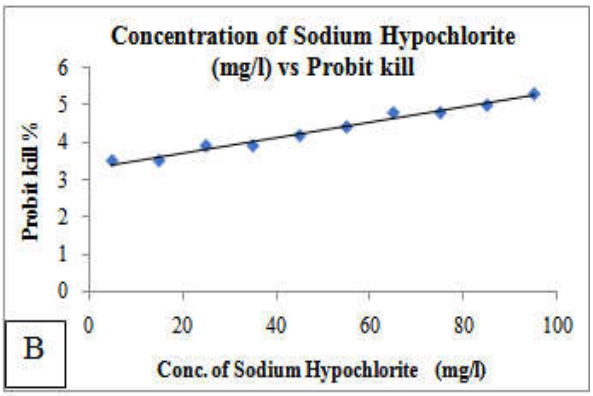
Sr. No.	Concentration of Sodiumhypochlorite (mg/l)	No. of Fishes Exposed	No. of Fishes died at 96hr	log concentration	Probit Kill%	Percentage mortality
1	05	14	01	0.698970004	3.52	7
2	10	14	01	1	3.52	7
3	15	14	02	1.176091259	3.92	14
4	20	14	02	1.301029996	3.92	14
5	25	14	03	1.397940009	4.19	21
6	30	14	04	1.477121255	4.42	28
7	35	14	06	1.544068044	4.8	42
8	40	14	06	1.602059991	4.8	42
9	45	14	07	1.653212514	5	50
10	50	14	09	1.698970004	5.3	64

Table 2: (C) LC50 value of Tilapia Mozambique exposed to different concentrations of Sodium Hydrosulphite for 96 hours

Sr. No.	Concentration of Sodium Hydrosulphite (mg/l)	No. of Fishes Exposed	No. of Fishes died at 96hr	log concentration	Probit Kill%	Percentage mortality
1	05	14	01	0.69897	3.52	7
2	10	14	03	1	4.19	21
3	15	14	04	1.176091	4.42	28
4	20	14	06	1.30103	4.8	42
5	25	14	07	1.39794	5	50
6	30	14	10	1.477121	5.52	70
7	35	14	12	1.544068	6.04	85
8	40	14	13	1.60206	6.41	92
9	45	14	14	1.653213	8.09	100
10	50	14	14	1.69897	8.09	100

The probit line graph with toxicity data and probit kill is shown in Figure 2.





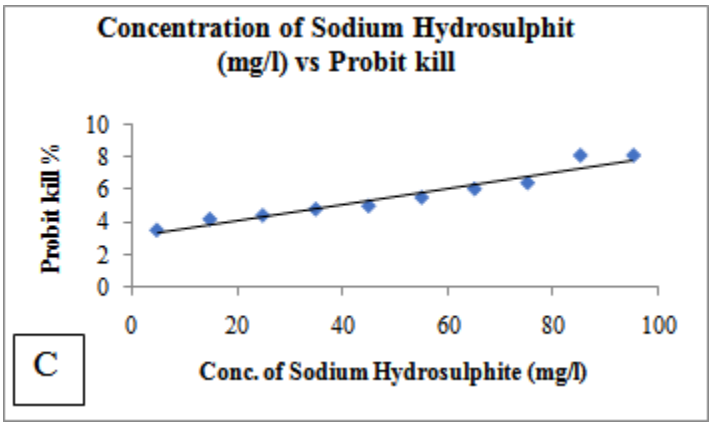
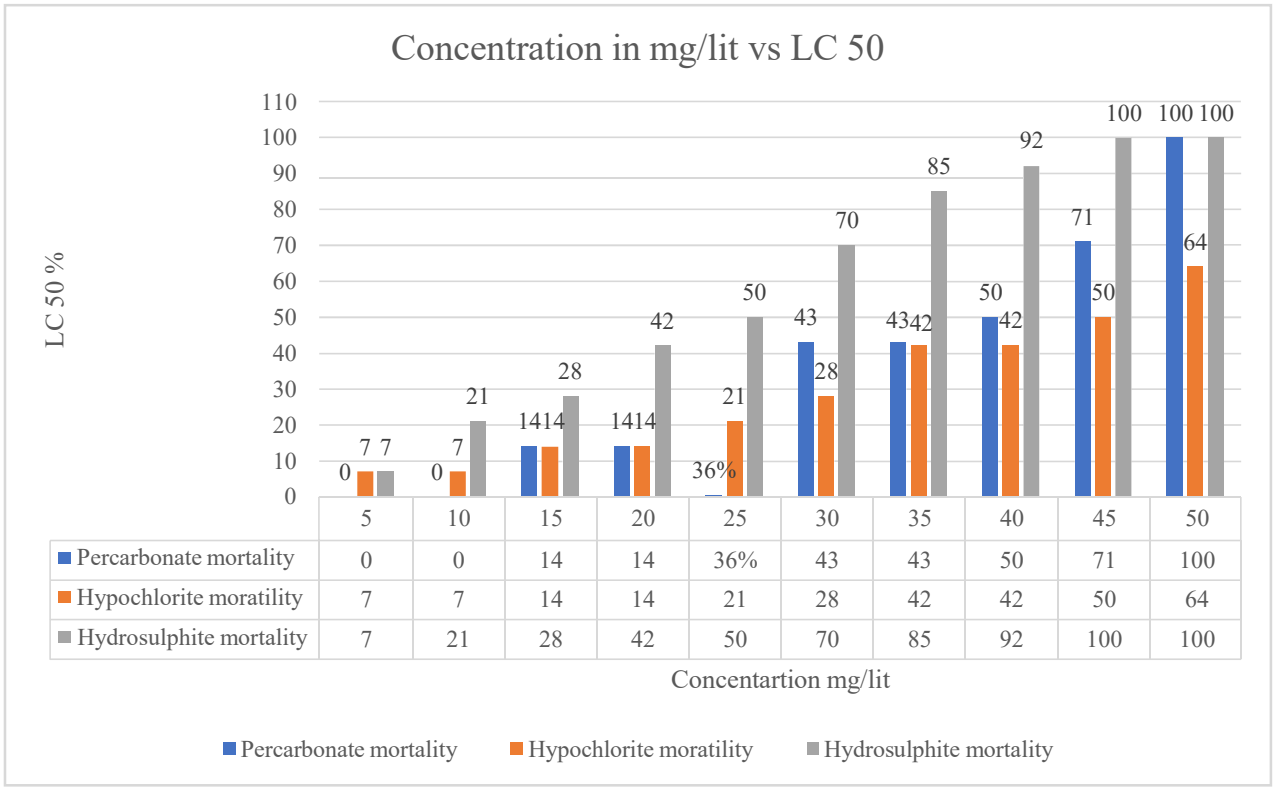


Figure 2: Probit line graph showing concentration of toxicant and probit kill – (A) Sodium Per carbonate. (B) Sodium Hypochlorite. (C) Sodium Hydrosulphite

A comparative median LC_{50} value against percent kill is shown in Figure 3. The 96 hr LC50 value for Sodium Percarbonate, Sodium Hypochlorite and Sodium Hydrosulphite was found to be 40 mg/L, 45mg/L and 25mg/L respectively.



	5	10	15	20	25	30	35	40	45	50
Percarbonate mortality	0	0	14	14	36%	43	43	50	71	100
Hypochlorite moratility	7	7	14	14	21	28	42	42	50	64
Hydrosulphite mortality	7	21	28	42	50	70	85	92	100	100

Figure 3: Comparative data of concentration of bleaching agents against Percent kill and median LC50 value

Toxicity testing is done to determine if a chemical has the potential to be toxic to organisms when present in the ecosystem. The present study was done to compare the toxicity of Sodium Percarbonate, Sodium Hypochlorite and Sodium Hydrosulphite in an aquatic ecosystem.The results indicated a positive relationship between the mortality and concentration levels of toxicant; when the concentration of toxicant increased it resulted in increase in mortality rate(Witeska, 2003). Figure 3 also shows that rate of mortality for any fixed time increased with increase in concentration and for a particular concentration with increase in exposure time. A comparative median LC_{50} value and percentage kill is shown in Figure 3. The 96 hr LC_{50} value for Sodium Percarbonate, Sodium Hypochlorite and Sodium Hydrosulphite was found to be 40 mg/L,

45mg/L and 25mg/L respectively. Lower the LD_{50} value the more toxic the chemical (Karasu and Koksal, 2005). When compared to the other two bleaching agent'sSodium Hydrosulphite has a lower LC 50 and hence it is more toxic. This is due to high solubility in water and can change the chemical properties of water and result in decreased oxygen. 96-hr LC_{50} for fish, Leuciscus idus was shown to be 62.3 mg/l, for Daphnia magna, 48-hr EC_{50} was 98.3 mg/l (OECD 2004). Higher LC_{50} values are less toxic as greater concentrations are required to produce 50% mortality (Basha and Rani, 2003) The LC_{50} for sodium Hypochlorite was high and was less toxic. The toxicity of bleaching agents was found in the following order of Sodium Hydrosulphite>Sodium Per carbonate>Sodium Hypochlorite. However, it was seen that as the concentration was increased, the mortality time decreased showing a negative relation.

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