

Evaluation of Toxicity of Bleaching Agents on Tilapia Fish

Fatema Zohra Momin and Nandita Singh

Department of Zoology, G. M. Momin Women's College, University of Mumbai.

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 LC₅₀ 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: LC₅₀, 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 (*Karhikeyan 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).

LC₅₀ is the concentration of a substance that is lethal to 50 percent of the organisms in a toxicity test. 96h LC₅₀ 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 LC₅₀ 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°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 calculate the 96-hr LC₅₀ 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 chlorpyrifos (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 LC₅₀ 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

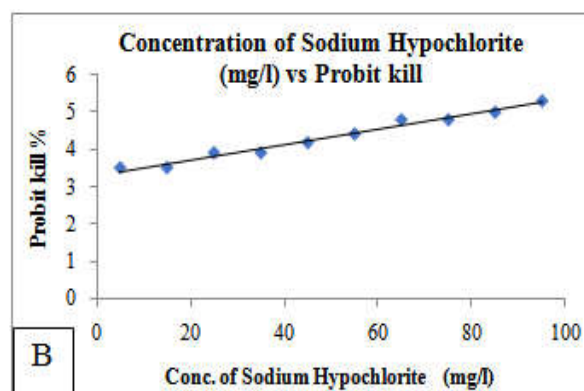
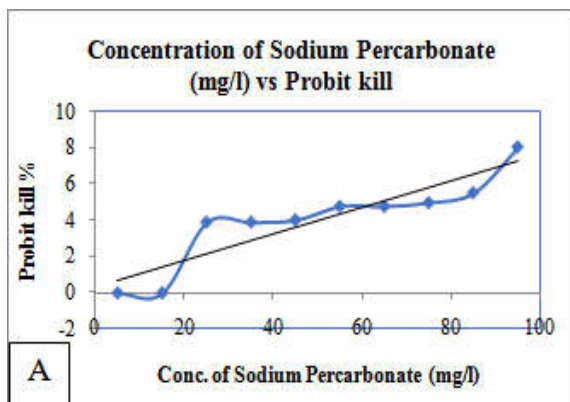
Table 2: (B) LC50 value of Tilapia Mozambique exposed to different concentrations of Sodium Hypochlorite for 96 hours

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.



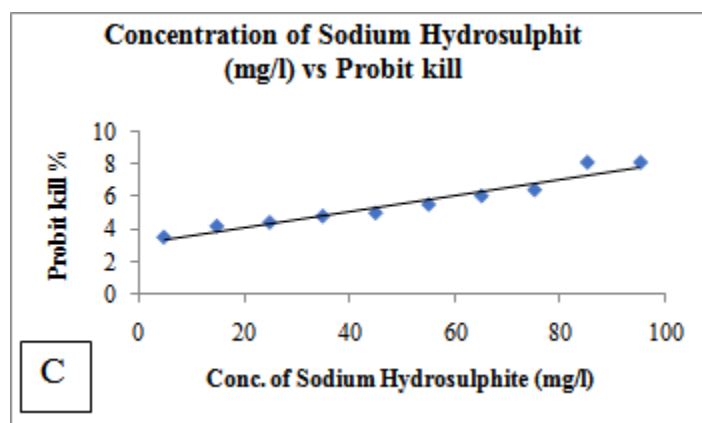


Figure 2: Probit line graph showing concentration of toxicant and probit kill – (A) Sodium Per carbonate. (B) Sodium Hypochlorite. (C) Sodium Hydrosulphite

A comparative median LC₅₀ 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.

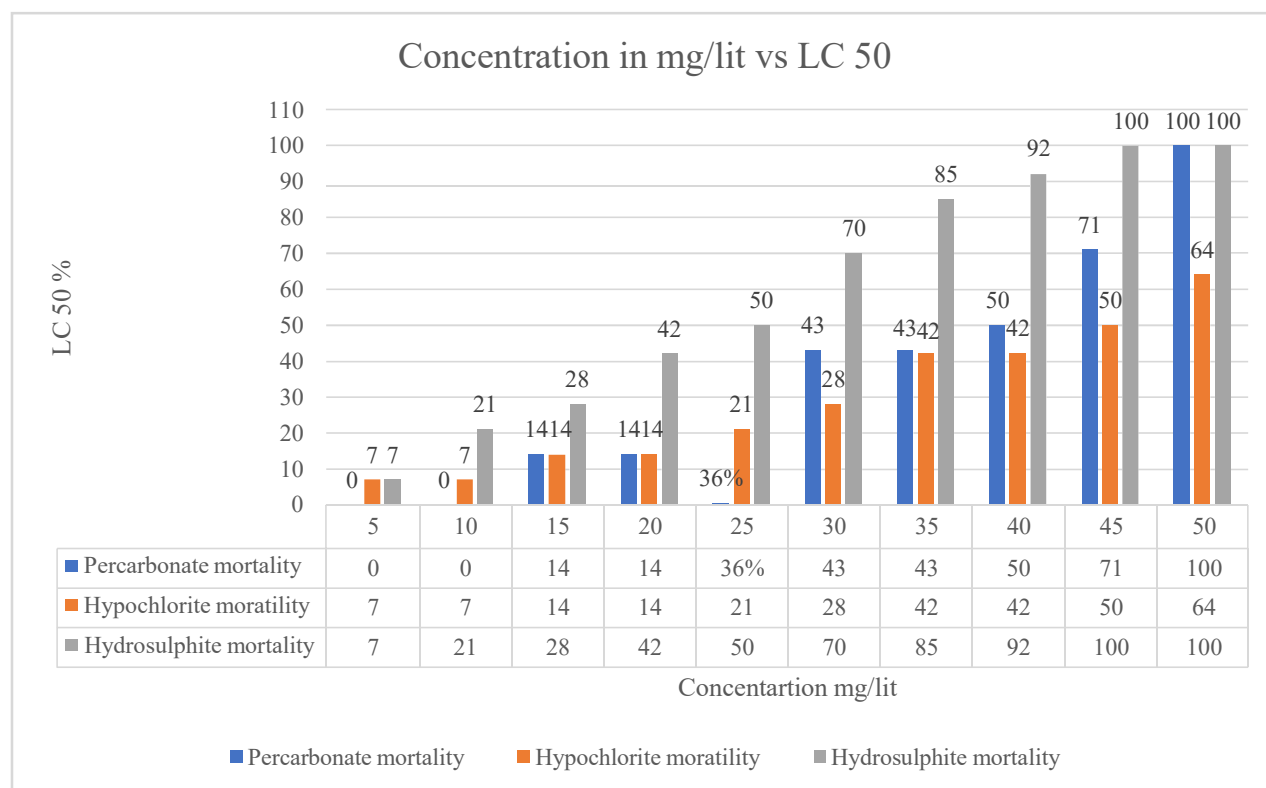


Figure 3: Comparative data of concentration of bleaching agents against Percent kill and median LC₅₀ value

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 LC₅₀ value and percentage 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. Lower the LD₅₀ value the more toxic the chemical (Karasu and Koksai, 2005). When compared to the other two bleaching agent's Sodium 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 LC₅₀ for fish, *Leuciscus idus* was shown to be 62.3 mg/l, for *Daphnia magna*, 48-hr EC₅₀ was 98.3 mg/l (OECD 2004). Higher LC₅₀ values are less toxic as greater concentrations are required to produce 50% mortality (Basha and Rani, 2003) The LC₅₀ 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.

REFERENCES

- [1]. Adewoye, S.O., O.O. Fawole and O.D. Owolabi: Toxicity of cassava a waste water effluents to African catfish: *Clarias gariepinus*. *Ethiop. J. Sci.*, 28, 189-194 (2005).
- [2]. Basha PS, Rani AU (2003) Cadmium-induced antioxidant defense mechanism in freshwater teleost *Oreochromis mossambicus* (tilapia). *Ecotoxicol Environ Saf* 56(2): 218-221.
- [3]. Das, M.K.: Fish health management in inland fisheries-A comprehensive study. *Environ. Ecol.*, 21, 72-78 (2003). Dey, S. and Islam, A. (2015): A review on textile wastewater characterization in Bangladesh. *Resource and Environment*, 5(1): 15-44.
- [4]. Finney, D. J., Ed. (1971). *Probit Analysis*. Cambridge, England, Cambridge University Press.
- [5]. Gereffi, G. (2002): Outsourcing and changing patterns of international competition in the apparel commodity chain. UNIDO's World Industrial Development Report, 2001
- [6]. Halappa R, David M. (2009): Behavioural responses of the freshwater fish, *Cyprinus carpio* (Linnaeus) following sublethal exposure to chlorpyrifos. *Turkish Journal of Fisheries and Aquatic Sciences*. 9:233-238
- [7]. Karasu Benlu A, Koksai GK (2005) the acute toxicity of ammonia on tilapia (*Oreochromis leucostictus* L.) larvae and fingerlings. *Turk J Vet Anim Sci* 29: 339-344.
- [8]. Karthikeyan S, Jambulingam M, Sivakumar P, Shekhar AP, Krithika J (2006): Impact of textile effluents on fresh water fish *Mastacembelus armatus* (Cuv. & Val). *J Chem* 3 : 303—306.
- [9]. Little, E.E., Finger, S.E., 1990. Swimming behavior as an indicator of sublethal toxicity in fish. *Environ. Toxicol. Chem.* 9, 13–19.
- [10]. Madhu Sharma. (2019): Behavioural responses in effect to chemical stress in fish: A review *International Journal of Fisheries and Aquatic Studies*: 7(1): 01-05.
- [11]. Sadat Sadeghil M.S. and S. Peery (2018): Evaluation of toxicity and lethal concentration (LC50) of silver and selenium nanoparticle in different life stages of the fish *Tenuualosailish* (Hamilton 1822) *Oceanography and Fisheries* Volume 7 Issue 5.
- [12]. Masud S, Singh IJ, Ram RN. (2005): Behavioural and hematological responses of *Cyprinus carpio* exposed to mercurial chloride. *Journal of environmental Biology*. 26:393-397.
- [13]. Michael J. B. (2012): Application of a novel open-source program for measuring the effects of toxicants on the swimming behavior of large groups of unmarked fish. *Chemosphere*; 86, 938–944.
- [14]. Nabi Bidhendi, G.R., Torabian, A., Ehsani, H. and Razmkhah, N. (2007): Evaluation of industrial dyeing wastewater treatment with coagulants and polyelectrolyte as a coagulant aid. *Iranian Journal of Environment Health Science and Engineering*, 4(1): 29-36.
- [15]. OECD SIDS (2004) : Initial Assessment Report For SIAM 19 Berlin, Germany, 19-22 October 2004 Chemical Name: Sodium dithionite.
- [16]. Roopadevi H.H and Somashekar R.K. (2012):: Assessment of the toxicity of waste water from a textile industry to *Cyprinus carpio*. *J. Environ. Biol.* 33, 167-171.
- [17]. Saini Rummi Devi (2017): Chemistry Department SMDRSD College, Pathankot, 145001, India *International Journal of Chemical Engineering Research*. Vol 9(1), pp. 121-136 Research India Publications <http://www.ripublication.com> Textile Organic Dyes: Polluting effects and Elimination Methods from Textile Waste.
- [18]. Siroka, Z. and Drastichová, J. (2004). Biochemical Marker of Aquatic Environment Contamination - Cytochrome P450 in Fish. A Review. *Acta Veterinaria Brno*. 73. 123-132.
- [19]. Vinodhini, R. and Narayanan (2009): The impact of toxic heavy metals on the hematological parameters in common carp (*Cyprinus carpio* L.). *Iran. J. Environ. Hlth. Sci. Eng.*, 6, 23-28.
- [20]. Witeska M, Jezierska B. (2003): The effect of environmental factors on metal toxicity of fish. *Fresen. Environ. Bull.* 12:824-9.