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Acute Toxicity Assessment of Textile Industrial Effluent of Pali city on Fresh Water Catfish, *Clarias batrachus* (Linn.)

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Abstract:
The discharge of untreated textile industrial effluent into freshwater bodies poses a significant threat to aquatic biodiversity. This study evaluated the acute toxicity of textile effluent collected from the Bandi River, Pali, on the freshwater fish *Clarias batrachus*. Bioassays were conducted using six graded concentrations (0%, 10%, 30%, 50%, and 70%) over an exposure period of 96 hours. Mortality data were analysed using probit analysis to determine Median Lethal Concentration (LC50) values. Results indicated that LC50 values decreased with increasing exposure time, recorded as 56.20%, 28.80%, 22.40%, and 16.60% at 24, 48, 72, and 96 hours, respectively. The safe concentration was determined to be 32.90%. The study concludes that textile effluent is highly toxic to *C. batrachus*, with mortality being both concentration and time-dependent.

Keywords: Acute Toxicity, *Clarias batrachus*, Textile industrial effluent, LC50, Probit Analysis.

1. INTRODUCTION

According to Makwana, S. (2020) water quality of aquatic habitat is altered due to anthropogenic activity. Recently more than 800 industrial units are carrying out dyeing and printing of cotton and synthetic clothes on large scale (Rathore, 2012)**.** Many studies were carried out in order to assess the impact of textile dyeing effluents on the surface water quality. (Rathore, 2011). Due to the widespread use of textile dyes, these toxic contaminants can be present in the environment and store biologically throughout the food chain in aquatic organisms (Hossain et al. 2018). Huge amount of water and chemicals are used in different processes which are discharged as waste water that are high in COD, BOD, TDS and toxic chemicals (Rao, M. and Makwana, S., 2025)

Industrialization, particularly the textile sector, is a major contributor to water pollution due to the discharge of dyes, heavy metals, and toxic chemicals. In regions like Pali, Rajasthan, the flow of textile effluent into the Bandi River has raised ecological concerns. Fish are excellent bio-indicators of aquatic health. *Clarias batrachus*, an air-breathing catfish, is often used in toxicological studies due to its local availability and relative hardiness. This study aims to determine the LC50 values and the safe concentration of textile industrial effluent (TIE) for *C. batrachus* to assess the environmental risk posed by these pollutants.

2. MATERIALS AND METHODS

2.1 Fish Collection and Acclimatization

Healthy *Clarias batrachus* were collected locally and transported in aerated bags. They were treated with 0.1% $KMnO_4$ to prevent dermal infections and acclimatized in glass aquaria for two weeks. During this period, fish were fed a protein diet, and water was renewed every 48 hours. Feeding was stopped 24 hours prior to the experiment.

2.2 Experimental Design

Following APHA (2000) guidelines, ten juvenile fish per group were exposed to effluent concentrations of 0% (control), 10%, 30%, 50%, and 70%. Mortality was monitored at 24, 48, 72, and 96-hour intervals. Dead fish were removed immediately.

2.3 Statistical Analysis

The LC50 values were determined using probit analysis (Finney, 1971), plotting probit mortality against log concentration. Safe concentration was calculated following the method described by Hart et al. (1945).

3. RESULTS

Table 1: Mortality rate of *Clarias batrachus* exposed to different concentrations of the effluent.

Mortality Percentage									
Concentration % (v/v)	**No. of fish**	**24 hrs**		**48 hrs**		**72 hrs**		**96 hrs**	
		M	M %	M	M %	M	M %	M	M%
Control	10	0	0	0	0	0	0	0	0
10 %	10	0	0	1	10	2	20	3	30
30 %	10	2	20	3	30	5	50	7	70
50 %	10	3	30	5	50	7	70	9	90
70 %	10	6	60	10	100	-	-	-	-

Table 2: Log concentrations and probit values when exposed to textile effluent after 24 h.

S. No.	**Conc. % (v/v) 24 hrs**	**Log Conc.**	**No. of Fish**	**24 hrs**	
				Mortality %	**Probit**
1	Control	0	10	0	0
2	10 %	1.0000	10	0	0
3	30 %	1.4771	10	20	4.1
4	50 %	1.6989	10	30	4.48
5	70 %	1.8450	10	60	5.25

Table 3: Log concentrations and probit values when the fish exposed to textile effluent after 48 h.

S. No.	**Conc. % (v/v) 48 hrs**	**Log Conc.**	**No. of Fish**	**48 hrs**	
				Mortality %	Probit
1	Control	0	10	0	0
2	10 %	1.0000	10	10	3.72
3	30 %	1.4771	10	30	4.48
4	50 %	1.6989	10	50	5
5	70 %	1.8450	10	100	7.37

Table 4: Log concentrations and probit values when the fish exposed to textile effluent after 72 h.

S. No.	**Conc. % (v/v) 72 hrs**	**Log Conc.**	**No. of Fish**	**72 hrs**	
				Mortality %	Probit
1	Control	0	10	0	0
2	10 %	1.0000	10	20	4.1
3	30 %	1.4771	10	50	5

4	50 %	1.6989	10	70	5.52
5	70 %	1.8450	10	100	7.37

Table 5: Log concentrations and probit values when the fish exposed to textile effluent after 96 h.

S. No.	Conc. % (v/v) 96 hrs	Log Conc.	No. of Fish	96 hrs	
				Mortality %	Probit
1	Control	0	10	0	0
2	10 %	1.0000	10	30	4.48
3	30 %	1.4771	10	70	5.52
4	50 %	1.6989	10	90	6.28
5	70 %	1.8450	10	100	7.37

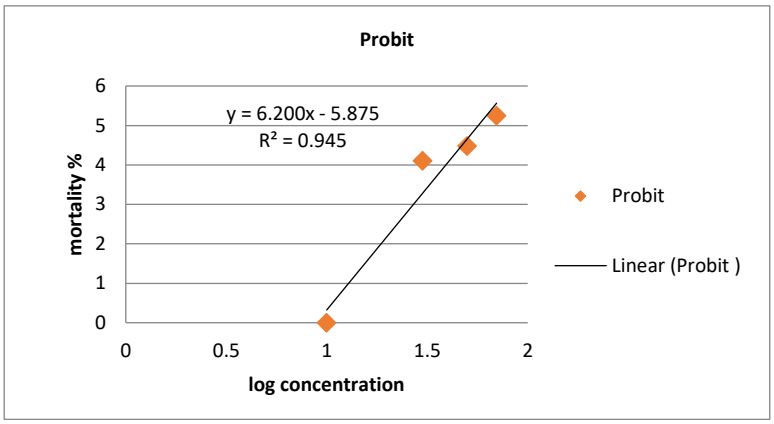

Fig.1: Linear regression curve of log concentration and mortality response of *C.batrachus* after 24 hrs. exposure to textile effluent.

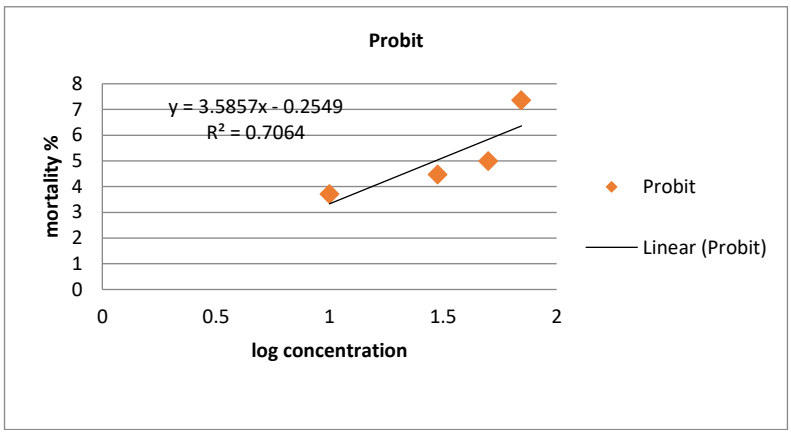

Fig.2: Linear regression curve of log concentration and mortality response of *C.batrachus* after 48 hrs exposure to textile effluent.

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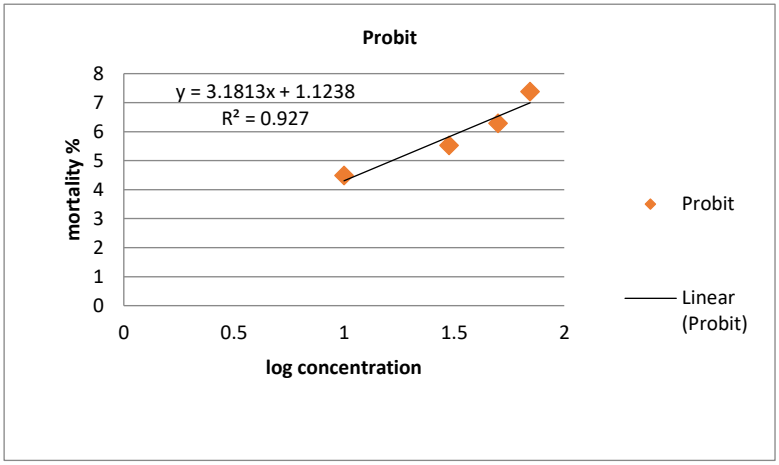

Fig.3: Linear regression curve of log concentration and mortality response of *C.batrachus* after 72 hrs exposure to textile effluent.

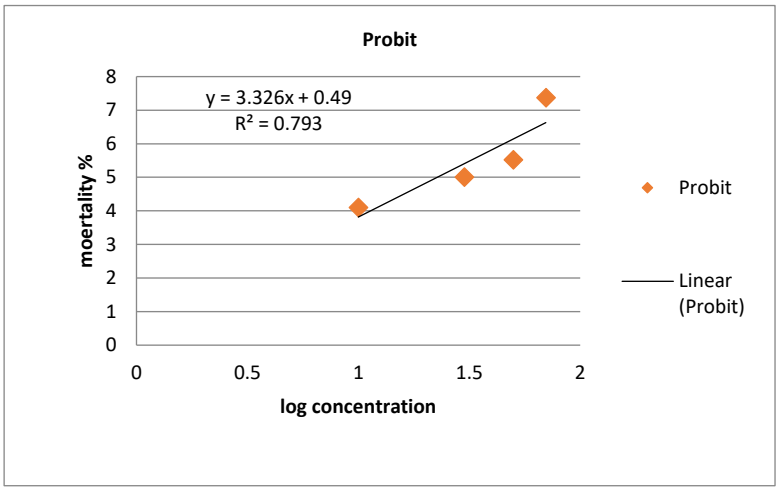

Fig.4: Linear regression curve of log concentration and mortality response of *C.batrachus* after 96 hrs exposure to textile effluent.

Table 6: Lethal concentrations of textile effluent at various exposure times for *C. batrachus*.

S.No	Time period	LC50 %	Regression line /slope	Coefficients	95% Confidence Interval		Safe concentration
					Lower Bound	Upper Bound	
1.	24 h	56.20	y = 6.200x - 5.875	6.1992 ±1.050	1.67725	10.72132	32.90 %
2.	48h	28.80	y = 3.585x - 0.254	3.5853±1.6343	-3.4468	10.6176	
3.	72 h	22.40	y = 3.181x + 1.123	3.3263±1.2012	-1.8422	8.4950	
4.	96h	16.60	y = 3.326x + 0.49	3.1810±0.6311	0.4654	5.8965	

Lethal concentration values in rows with different letters significantly differ at $p < 0.05$.
No mortality occurred in the control group. In treated groups, mortality increased significantly with higher concentrations and longer exposure (Table 1). The safe concentration of the effluent was found to be **32.90%**. Linear regression curves confirmed a strong positive correlation between log concentration and probit mortality across all time intervals.

4. DISCUSSION

The results exhibit that the textile effluent is highly toxic to *C. batrachus*. As time increases, LC50 decreases. The inverse relationship between exposure time and LC50 values suggests a cumulative toxic effect. This is due to the presence of chemical dyes and heavy metals which alter water quality and physiological functions. Similar conclusions have been reported by Sreelekshmy et al. (2016) regarding impact of industrial effluents on catfish.

5. CONCLUSION

The study confirms that textile industrial effluent from the Pali region is lethal to *Clarias batrachus* even at relatively low concentrations over 96 hours. The high mortality rates indicate the urgent need for severe effluent treatment protocols before discharge into natural water bodies to protect aquatic life and the surrounding ecosystem.

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