

EVALUATING THE TOXIC EFFECTS OF INDUSTRIAL EFFLUENT ON EARTHWORM (*Eisenia fetida*)

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Abstract:

Industrial effluents contain various toxic pollutants that pose serious threats to soil ecosystems. This study investigated the toxic effects of industrial effluent on the earthworm, a widely recognized bio indicator of soil health, under controlled laboratory conditions. Earthworms were exposed to different concentrations of industrial effluent mixed with soil to evaluate both lethal and sublethal effects. Toxicity was assessed by observing changes in behavior, physical structure, survival rate, and reproductive performance. Behavioral responses such as reduced movement, surface migration, and stress-related symptoms were observed in exposed earthworms. Physical abnormalities and increased mortality were more prominent at higher effluent concentrations. A significant reproductive capacity was also recorded, indicating adverse effects on earthworm population sustainability. These biological responses clearly reflected the harmful impact of effluent-contaminated soil. physio-chemical analysis of the industrial effluent revealed poor water quality, with unfavourable values of parameters such as pH, BOD, COD, DO, TDS. These parameters confirmed the presence of pollutants capable of disrupting soil life. The findings demonstrate that industrial effluents can cause serious damage to soil organisms even at relatively low concentrations, leading to reduced soil fertility and ecosystem imbalance. The study highlights the ecological risks associated with the improper discharge of untreated industrial wastewater into the environment. It also confirms the suitability of *Eisenia fetida* as a sensitive and reliable bio-indicator for soil toxicity assessment. Overall, the study emphasizes the importance of effective industrial effluent treatment and proper waste management practices to protect soil health and ensure sustainable environmental management.

1. INTRODUCTION

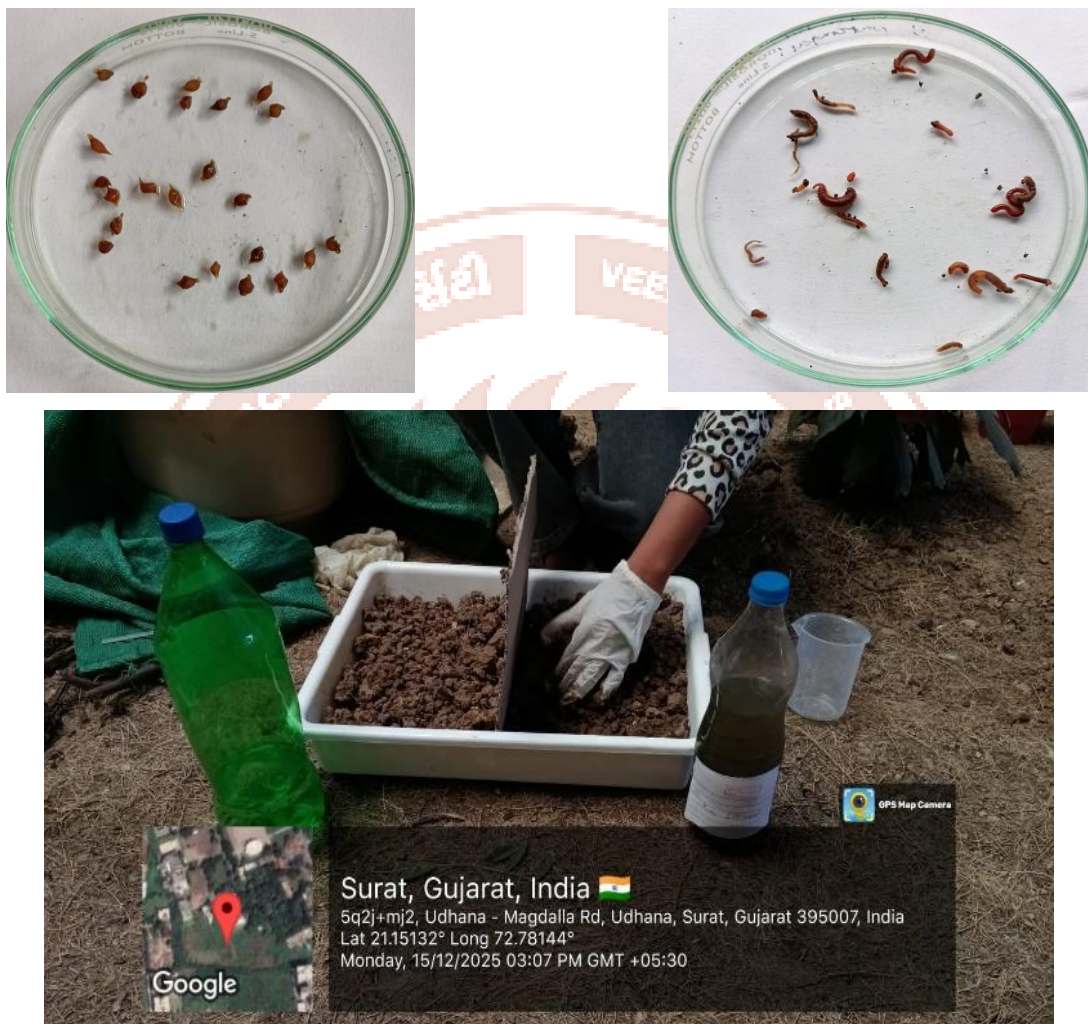
Industrial effluents adversely affect soil ecosystems. Earthworms are widely accepted as sensitive bioindicators because they respond rapidly to environmental contaminants. The present investigation evaluated the toxicological effects of industrial effluent using *Eisenia fetida*.

2. MATERIALS AND METHODS

Earthworms were cultured under controlled laboratory conditions and exposed to different industrial effluent concentrations. Physicochemical analyses, avoidance tests, mortality studies, biomass measurements, morphological observations and dissections were performed.

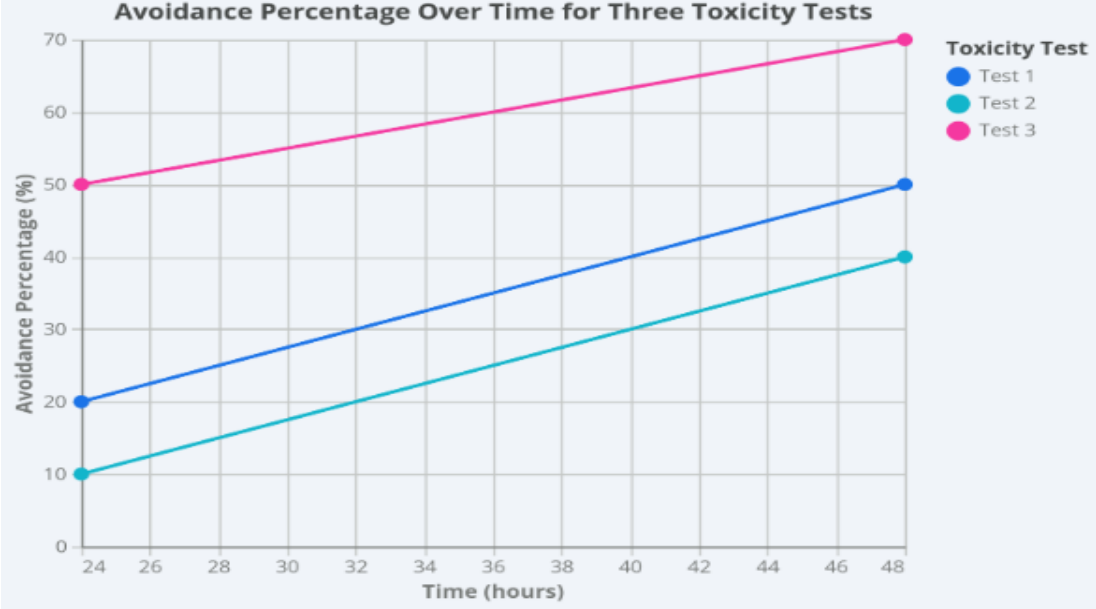
3. RESULTS AND DISCUSSION

Successful culture establishment was achieved. Avoidance behaviour increased with Toxicant exposure. No mortality occurred up to 60% concentration, whereas mortality reached 15.38% and 25% at 80% and 100% concentrations respectively. Morphological abnormalities and biomass changes indicated sublethal toxicity.



Culturing

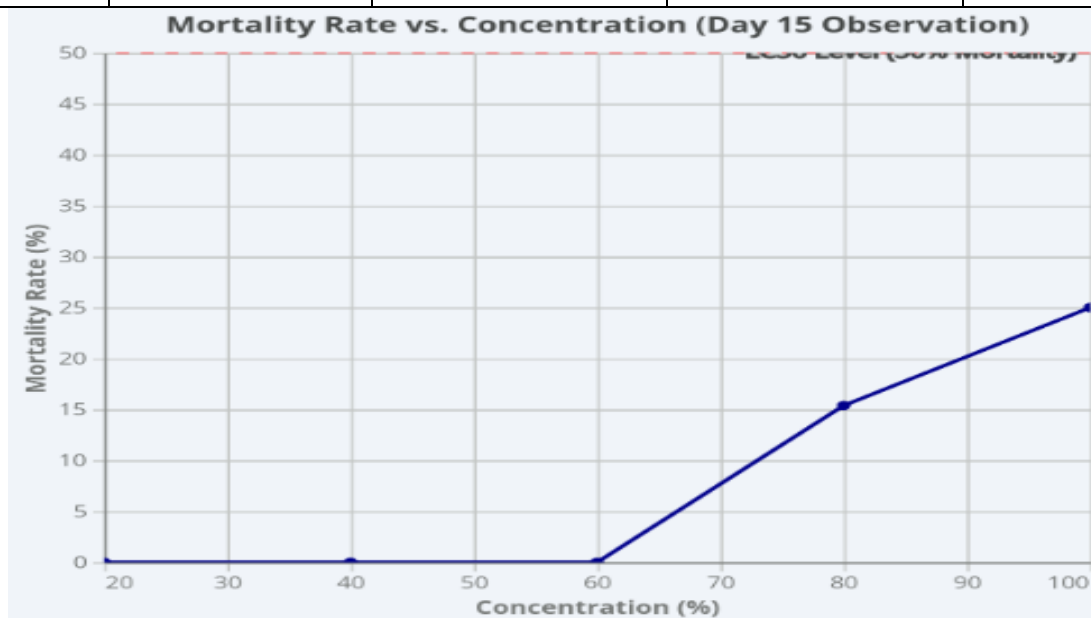
Parameter	Observation
Species	<i>Eisenia fetida</i>
Duration of Culturing	47 Days (14 Nov 2025 – 31 Dec 2025)
Initial Population	311 (Adults)
Final Population	665 (Adults + Juveniles)
Reproductive Status	Active (Cocoons and hatchlings observed)
Net Increase	+354 individuals (~114% growth)



Avoidance Behavior of *Eisenia fetida* over 48 Hours

Time Duration	Total Earthworms	Count in Tap Water (Control)	Count in Effluent (Toxicant)	Avoidance (%)
24 Hour	20	12	8	20%
48 Hour	20	15	5	50%
24 Hour	20	11	9	10%
48 Hour	20	14	6	40%

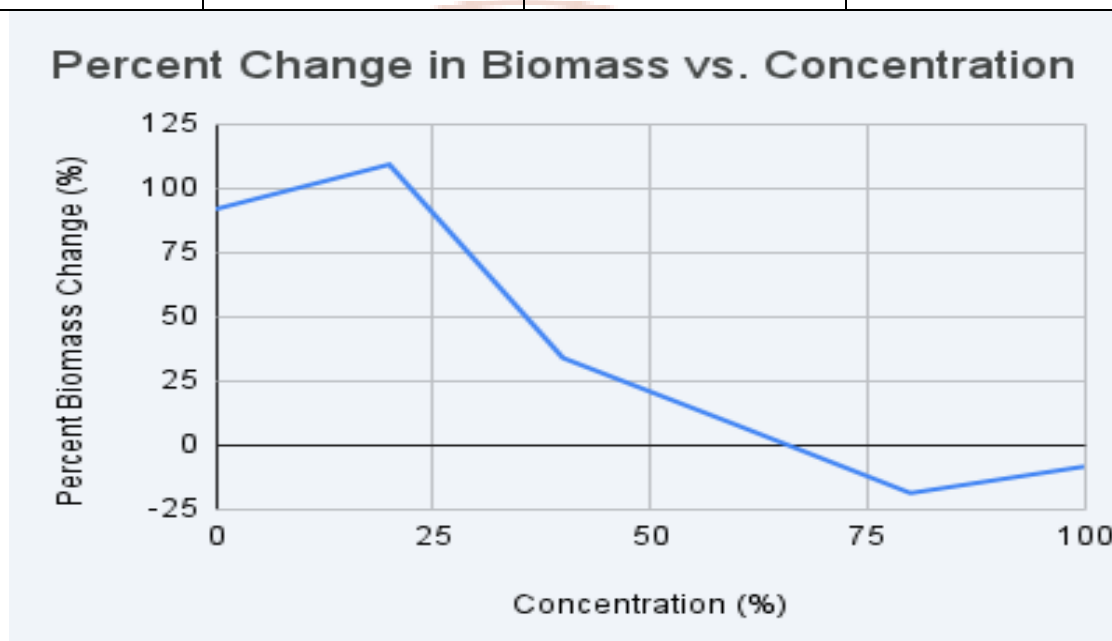
24 Hour	20	15	5	50%
48 Hour	20	17	3	70%



Mortality vs concentration



Concentration	Total No. Earthworms	Dead Earthworms	Mortality Rate (%)
Control 190	190	0	0.00%
20 %	35	0	0.00%
40 %	32	0	0.00%
60 %	31	0	0.00%
80 %	26	4	15.38%
100 %	24	6	25.00%

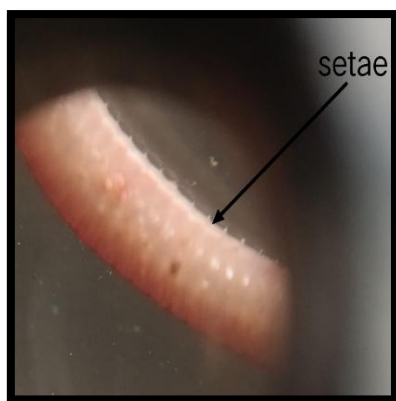


Biomass changes.

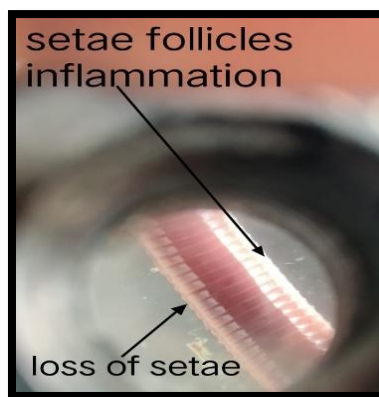
3.4 Morphological and Anatomical Alterations

Microscopic observation of the epidermal surface revealed severe damage to locomotive structures, specifically loss of setae and inflammation of setae follicles in earthworms exposed to 100% effluent compared to intact structures in the control group.

Dissection and internal anatomical analysis demonstrated significant pathological degeneration. Earthworms exposed to 100% concentration exhibited gastrointestinal distension, opaque coelomic fluid, asymmetrical yellowish seminal vesicles, and marked loss of muscular definition.



Control



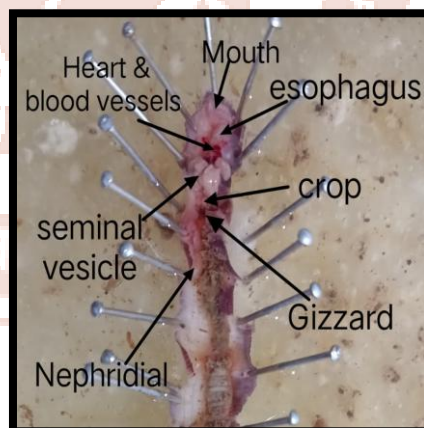
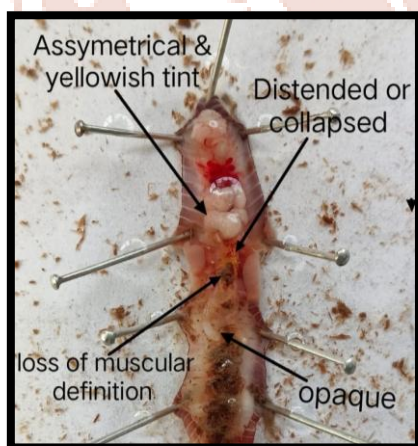
100% effluent concentration



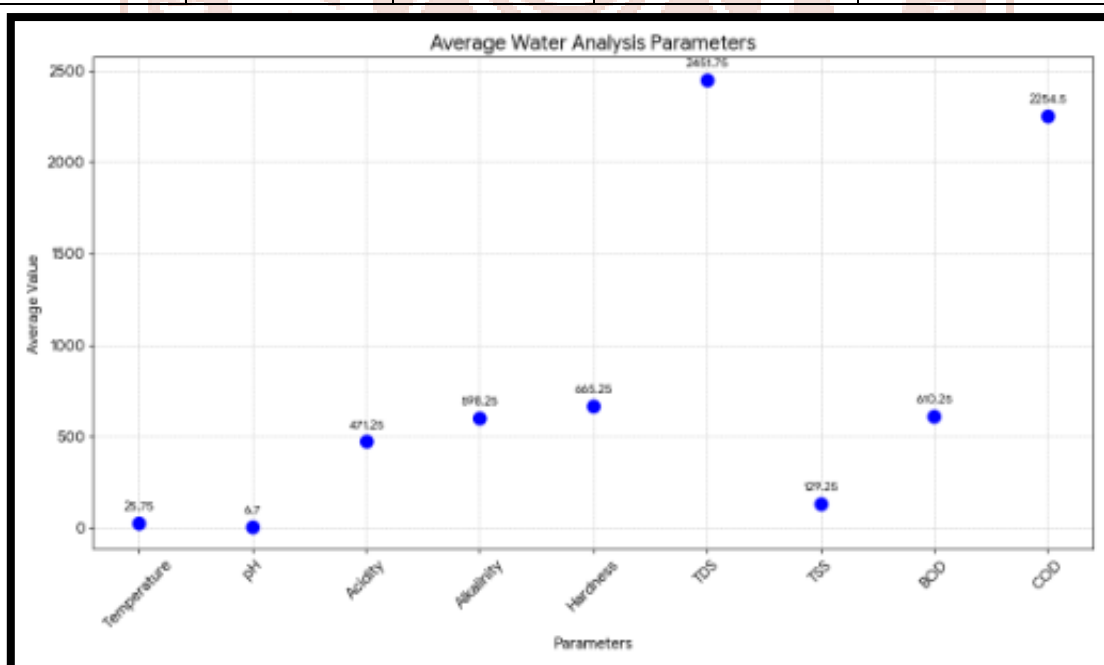
Control



100 % effluent concentration



Concentration	Initial Weight (g)	Final Weight (g)	Net Weight Change (g)	Percent Biomass Change (%)
Control	18.69	35.81	+17.12	+91.60%
20%	6.12	12.79	+6.67	+108.99%
40%	7.49	10.01	+2.52	+33.64%
60%	6.51	7.00	+0.49	+7.53%
80%	7.54	6.11	-1.43	-18.97%
100%	12.26	11.20	-1.06	-8.65%



Water analysis

Parameter	Average Value
Temperature	25.75 C
pH	6.7
Acidity	471.25 mg/l
Alkalinity	598.25 mg/l
Hardness	665.25 mg/l
TDS (Total Dissolved Solids)	2,451.75 mg/l
TSS (Total Suspended Solids)	129.25 mg/l
BOD (Biochemical Oxygen Demand)	610.25 mg/l
COD (Chemical Oxygen Demand)	2,254.50 mg/l

4. Figure Suggestions

Figure 1. Earthworm culture.

Figure 2. Avoidance behaviour.

Figure 3. Mortality vs concentration.

Figure 4. Biomass changes.

Figure 5. Water analysis

Figure 6. Morphological alteration in setae of Earthworm

Figure 7. Anatomical and Histological Alterations (Internal Damage)

Figure 8. Morphological Alterations (External Damage)

5. CONCLUSION

Industrial effluent exhibited concentration-dependent toxicity towards *Eisenia fetida*. Earthworms proved effective bioindicators for environmental monitoring.

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