# MORTALITY RATES OF JUVENILE AFRICAN CATFISH (C*LARIAS GARIEPINUS)* EXPOSED TO DICHLORVOS INSECTICIDE

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**ABSTRACT**
*This study investigated the impact of Dichlorvos (DDVP) insecticide on the mortality rates of fish exposed to various concentrations of DDVP. Juvenile African catfish were procured and acclimated for two weeks in dechlorinated water under natural conditions. A total of 150 fish were randomly allocated into five treatment groups in triplicate, each containing 10 fish, and exposed to various concentrations of DDVP based on a 96-hour LC50 of 0.00056 ml/L. The experimental groups included T1 (control,* no DDVP*), T2 (0.000112 ml DDVP/L), T3 (0.000224 ml DDVP/L), T4 (0.000336 ml DDVP/L), and T5 (0.000448 ml DDVP/L). Temperature and pH of experimental water were monitored daily. Fish mortality was assessed at multiple time points throughout the experiment, with dead fish removed promptly to prevent oxygen depletion. Results showed that mortality rates were significantly ($p < 0.05$) higher in T4 (85.00 ± 7.07%) and T5 (100.00 ± 0.00%) compared to T1 (0.00 ± 0.00%), T2 (15.00 ± 7.07%) and T3 (20.00 ± 14.14%). T4 and T5 exhibited the highest mortality rate among all treatments. This study highlights the detrimental effects of DDVP on the health of Clarias gariepinus, with higher concentrations leading to increased mortality rates.*
**Keywords**: **DDVP (Dichlorvos) insecticide, African catfish, Mortality**

## INTRODUCTION

*Clarias gariepinus*, commonly known as the African catfish, is notable for its exceptional tolerance to environmental pollutants. This species can thrive in a variety of polluted aquatic environments due to several key adaptations. It possesses a high degree of metabolic and physiological resilience, allowing it to cope with contaminants such as heavy metals and pesticides (Amaeze *et al.,* 2020). The ability of catfish to perform aerial respiration, alongside its gill-based breathing, enables it to survive in oxygen-depleted waters often associated with pollution. Pesticides are synthetic organic and inorganic compounds used to kill or contain the activities of pests. According to Doherty *et al.* (2016), pesticides affect all members of an ecosystem from the smallest vertebrates to birds and humans, and their toxicities to both urban and agricultural settings are responsible for the death of many fishes, birds and smaller aquatic animals that fish depend on for food. In their separate studies, Amaeze *et al.* (2020) showed that aquatic contamination by pesticides caused acute and chronic poisoning of fish as well as severe damage to vital organs. It has also been shown that humans are at risk of exposure to pesticides either through skin, oral consumption or respiration. There is evidence of bio-accumulation of pesticides at higher trophic levels with possible deleterious effects. The major insecticides that are usually used are organophosphate, organochlorine, carbamates, pyrethroids and necotenoides.

The effects of insecticides and pesticides on the mortality rates of catfish can be quite significant, reflecting broader concerns about their impact on aquatic ecosystems. Dichlorvos (DDVP) insecticide is one of the most currently and widely used insecticides in this part of the world and several studies have detected its presence in water bodies at levels above the limits determined by local and international authorities.

## MATERIALS AND METHODS

### Experimental Design

A 12week completely randomized design (CRD) feeding trial was conducted at the Department of Fisheries Technology, and fish were procured from the Teaching and Research Farm of the Federal Polytechnic Ado Ekiti, Ekiti State. Juvenile fish were used in the experiment because they are more susceptible to environmental changes than older/more mature fishes. 10 healthy juveniles of *Clarias gariepinus,* regardless of sex were randomly selected, weighed, distributed and replicated thrice into five plastic aquarium tanks (42.5 × 30.5 × 22.5 cm) which contained 50 liters of dechlorinated water 150 fish. For the range finding test, four healthy fish were selected into an aquarium tank containing 15 L of water after which DDVP insecticide were added to determine the $LC_{50}$. The experiment was designed into five treatments with concentration of DDVP insecticide below the determined $LC_{50}$ (0.00056 ml/L) as presented in Table 1.

**Table 1: Concentration of DDVP in each Treatment**

| T1 (control) | T2 | T3 | T4 | T5 |
|---|---|---|---|---|
| No DDVP 0.0000 ml/L | 0.000112 ml/L | 0.000224 ml/L | 0.000336 ml/L | 0.000448 ml/L |

**Water Quality Monitor**

Temperature and pH of the test solution and the control were monitored every 24 hours using mercury in glass thermometer and pH meter (American Public Health Association, 2005).

**Sub-lethal toxicity bioassay**

Based on the results of the range finding test, the 96-hours $LC_{50}$ were calculated as 0.00056 ml/L and used to determine the concentrations of DDVP insecticide used during the sub-lethal toxicity bioassay (Ali *et al*., 2018; Amaeze *et al.,* 2020). Fresh specimens were exposed to concentrations below the $LC_{50}$ (0.00056 ml/L) as earlier stated in the five treatments. A total of one hundred and fifty fish were used. 15 plastic aquaria were used for the sub-lethal experiment. Fish were fed with pelleted commercial feed at 5 % body weight daily which were split into 2 rations.

**Data Collection**

Effect of treatments on fish mortality was studied at the end of 1, 2, 4, 6 and 12 hours post exposure and then twice daily before termination of the experiment. Dead fish were immediately removed to avoid dissolved oxygen depletion (Kumari, 2020).

**Statistical analysis**

Data were analysed using Statistical package for social sciences version 20 (SPSS, 2014). The data were expressed as mean ± standard deviation and multivariate analysis of variance (New Duncan Multiple Range Test) was used to show significant variations at $p<0.05$.

**RESULTS**

The mortality rates of fish exposed to different concentrations of DDVP insecticide are presented in Table 2. The Table revealed that the mortality rates in T4 (85.00 ± 7.07%) and T5 (100.00 ± 0.00%) are significantly higher ($p<0.05$) compared to others.

**Table 2: Mortality rates of *Clarias gariepinus* exposed to DDVP insecticide**

| | T1 | T2 | T3 | T4 | T5 |
|---|---|---|---|---|---|
| Mortality | $0.00{\pm}0.00^a$ | $1.50{\pm}0.71^a$ | $2.00{\pm}1.41^a$ | $8.50{\pm}0.71^b$ | $10.00{\pm}0.00^b$ |
| %Mortality | $0.00{\pm}0.00^a$ | $15.00{\pm}7.07^a$ | $20.00{\pm}14.14^a$ | $85.00{\pm}7.07^b$ | $100.00{\pm}0.00^b$ |

Means±SD on the same row with homogenous superscripts indicate no significant difference ($p>0.05$).

**DISCUSSION**

The results demonstrated a clear dose-response relationship between DDVP exposure and fish mortality. At lower concentrations (T1, T2 and T3), the mortality rates remained relatively low, indicating a lower acute toxicity of DDVP at these levels. In contrast, higher concentrations (T4 and T5) resulted in substantially higher mortality rates, reflecting increased toxicity. The significantly higher mortality rates observed in T4 and T5 suggest that the concentration of DDVP at these levels is lethal to a large proportion of the fish population. This is consistent with the known effects of organophosphate insecticides, which are known to disrupt acetylcholine esterase activity, leading to neurotoxic effects and potentially high mortality rates in aquatic organisms. The lower mortality rates in the control (T1), T2 and T3 may be attributed to the sub-lethal concentrations of DDVP, where the fish are exposed to levels that are not immediately fatal but could still induce stress or sublethal effects. This finding, which showed a significant increase in fish mortality with higher concentrations of DDVP insecticide, aligns with the research of Khan *et al*. (2018), which demonstrated that exposure to various pesticides, including organophosphates, results in higher mortality rates among fish at elevated concentrations and that even sub-lethal doses can impact fish health and behaviour. The lower mortality rates in T1, T2 and T3 at lower concentrations aligns with Mishra and Gupta (2014), who found that lower concentrations of pesticides could result in sub-lethal effects, such as stress and behavioral changes, without immediate high mortality. Mishra and Gupta (2014) emphasized that even sub-lethal doses could impact fish health, affecting growth and reproduction, which underscores the importance of not only considering lethal effects but also sub-lethal impacts in environmental assessments.

The high mortality rates (85% and 100% in T4 and T5 respectively), recorded in this study, correspond with the findings of Singh and Sharma (2018) who reported that mortality rates in fish exposed to high doses of organophosphates often exceeded 70%, which is consistent with the mortality rates observed in our T4 and T5 treatments. The results suggest that high concentrations of DDVP pose a severe risk to fish populations, which aligns with García and Martínez (2017) who reported that pesticide exposure can lead to substantial mortality and disrupt aquatic ecosystems.

## CONCLUSION

The study established that exposure of *Clarias gariepinus* to DDVP insecticide shows a clear dose-dependent increase in mortality rates. This study recommends that it is crucial to monitor and regulate the use of DDVP in aquatic environments to prevent harmful effects on fish populations.

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