



Mortality Rate of *Clarias gariepinus* Fingerlings Exposed to 2, 3- dichlorovinyl dimethyl Phosphate

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Authors' contributions

This paper was carried out by all the authors. Author ASO conceived the idea. Author SCI carried out the bioassay. Author GR managed literature search. Authors ASO and SCI carried out the statistical analysis. While author SCI wrote the initial draft. Authors GR and ASO edited the manuscript. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

2, 3- dichlorovinyl dimethyl phosphate is an organophosphate insecticide used in the control of insects in both agricultural and household. This study investigated the mortality rate of *Clarias gariepinus* fingerlings exposed to 2, 3- dichlorovinyl dimethyl phosphate. Samples *Clarias gariepinus* were bought from a private fish farm in Yenagoa metropolis, Nigeria. The fishes were acclimatized in the laboratory for 3 days. A static renewal bioassay methodology was adopted. Results showed mortality rate of 32.85, 57.14 and 72.86% at 0.20, 0.60 and 1.00 ppm respectively (based on different concentration) and 32.67, 43.33, 56.67 and 73.33% respectively at intervals of 12, 24, 48 and 96 hours (based on time). There was significance difference ($P < 0.05$) with respect to concentration, time and interaction of time/concentration. Results also showed increased mortality with increased concentration and exposure duration. The results showed that even at low concentration, 2, 3- dichlorovinyl dimethyl phosphate could still induce mortality in fingerlings of *Clarias gariepinus*. As such caution should be exercised in the use and disposal of empty cans of 2, 3- dichlorovinyl dimethyl phosphate close to aquatic-systems.

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1. INTRODUCTION

Water is one of the unique resources required for the growth, development and survival of living organisms [1-6]. Water resources are majorly contaminated by human activities and to a lesser extent by natural phenomena [7]. Beside portability and domestic utilization especially by humans, water is also habitat to several aquatic life forms including fishes (fin and shelled fishes). Fish is a major source of animal protein. The harvesting of fishes in the wild (fishing) is a major source of livelihood to indigenous people especially in Bayelsa state, Nigeria. Industrialization and urbanization has led to constant degradation of the environment (soil, air and water) resulting in eutrophication and loss of biodiversity.

Surface water abounds in Nigeria. According to Izah and Srivastav [4], over 10 out of the 36 states are named after water bodies. Nigeria as a nation is divided into three by rivers. Several rivers, creeks and lakes are named after a town. According to Olopade et al. [8], several communities and towns lie in the watershed of the Niger River, and other major river systems include the Benue River, Cross River, Anambra River, Imo River, Kwa Iboe River, Ogun River and Oshun River. Majority of these rivers has tributaries.

Specifically, in the Niger Delta, freshwater, brackish and marine water are found in the region. The sizes of the water differ and are called by several names including lake, pond, creek, creeklets, stream, rivulets, river etc. The water resources are major receipt of wastes generated by several sector including household and industry. Some notable pollutants aquatic resources emanates from erosion, siltation, domestic and industrial wastes, effluent from abattoir, motor garages, mechanical shops, excreta disposal, agricultural activities as well as bathing and washing [8]. These wastes are discharged into the water directly and indirectly (via runoff after rainfall). In river line communities in the Niger Delta specifically Bayelsa state, several wastes streams are discharged into the aquatic ecosystem including sewage via pit toilet system [2,6,9,10], food processing wastes such as oil palm mill effluents [11], household and market solid wastes. The activities leading to changes in water quality parameters could also

affect the composition and abundance of life in such water medium.

In recent times, synthetic pesticides are used for the eradication of weed (herbicides), insects (insecticides), ticks (acaricides) etc. Typically, pesticides are substances used to control pest (in order to protect crop and preserve materials, eradicate weeds, control disease transmitting vectors/organisms) [12-14]. Most toxic pesticides are harmful to non-target organisms.

In coastal region especially in the Niger Delta, the use of insecticides containing 2, 2-Dichlorovinyl Dimethyl Phosphate has increased. Ajiboso et al. [15] reported that 2, 2-dichlorovinyl dimethyl phosphate is one of the commonly produced and utilized insecticides in Nigeria with effectiveness and potency compared to other competitive household insecticides (including mosquito coil and flints).

2,3dichlorovinyl dimethyl phosphate is one of the pesticides that belong to the organophosphates group of insecticides. 2, 3-dichlorovinyl dimethyl phosphate is sometimes called dichlovos [16, 17]. It is one of the broad spectrum insecticides used in the control of household, and stored products insects [16,17]. According to Ashade et al. [16], the toxicity of the organophosphate is due to their ability to inhibit cholinesterase enzyme which results in the accumulation of acetylcholine in nerve tissues of the effector organs. Organo-phosphates are broader in insecticidal spectrum.

Handling and use of insecticides containing 2,3dichlorovinyl dimethyl phosphate is indiscriminate. Generally, the discharge of empty cans of pesticides could be harmful to the environment. This is because the remains in the cans could be toxic to aquatic ecosystem especially fishes when they are leached into the nearby surface water due to soil erosion [18-25]. Furthermore, Babatunde and Oladimeji [26] reported that pesticides usually get into the aquatic environment through accidents or through run offs from surrounding farmlands and leads to mortality and morbidity in aquatic-system such as fisheries. Therefore, this study is designed to assess mortality rate of Juvenile *Clarias gariepinus* exposed to 2, 3dichlorovinyl dimethyl phosphate.

2. MATERIALS AND METHODS

2.1 Source of Fish, Transportation and Acclimation

Clarias gariepinus fingerlings were purchased from a private fish farm in Yenagoa metropolis, Bayelsa state. The fish samples were transported to the laboratory in 20 liter rubber cans covered with fishing net. The fish was allowed to acclimatize in circular rubber aquaria for 3 days. During which they were fed with normal coupon fish diet (fish meal) at 5% body weight for week. A static renewal bioassay was employed for the study.

2.2 Range finding and Main Test

The toxicant was prepared into lower concentrations from manufacturer stock of 1000 g/l. The medium were renewed at every 12 hours and fed one daily. A range finding test of 2.50, 5.00, 7.50, 10.0 ppm was carried out for 48 hours. Based on the result of the range finding test, the main experiment was carried out using the same procedure as the trial test and lowering the concentration of the 2, 3 dichlorovinyl dimethyl phosphate for a period of 96 hours. The toxicant was renewed at every 12 hour. Six experimental treatments/groups were carried out, with each containing 10 fishes. The final concentrations of the toxicant used were 0.00, 0.20, 0.40, 0.60, 0.80 and 1.00 ppm. This was carried out by diluting the original stock concentration of 1000 g/l till the desired concentration was achieved. Borehole water was used as the diluent.

Mortality in the fishes occurred when the fish did not respond to repeated prodding. The mortality (in number) was recorded after exposure. Percentage mortality was calculated. The LC_{50} was estimated based on the method previously used by Ohimain et al. [27,28], Angaye et al. [29 – 34].

2.3 Statistical Analysis

Statistical package for social sciences software was used for the statistical analysis. Two way analysis of variance was carried at $P=0.05$ and Duncan multiple range test statistics was used for mean separation.

3. RESULTS AND DISCUSSION

The mortality rate of *Clarias gariepinus* fingerlings exposed to different concentration of 2, 3 dichlorovinyl dimethyl phosphates is presented in Fig. 1. Mortality rate of 32.85, 57.14 and 72.86% was attained at 0.20, 0.60 and 1.00 ppm respectively. The concentration of the toxicant that could cause 50% mortality in the fish is 0.41 ppm. Furthermore, mortality rate of the *Clarias gariepinus* fingerlings exposed to 2, 3- dichlorovinyl dimethyl phosphate at varying time interval is presented in Fig. 2. Mortality rate at 12, 24, 48 and 96 hours of exposure were 32.67, 43.33, 56.67 and 73.33% respectively. There was significance difference ($P<0.05$) among the various concentrations of the toxicants. Significant variation ($P<0.05$) also exist in the interaction of time and concentration.

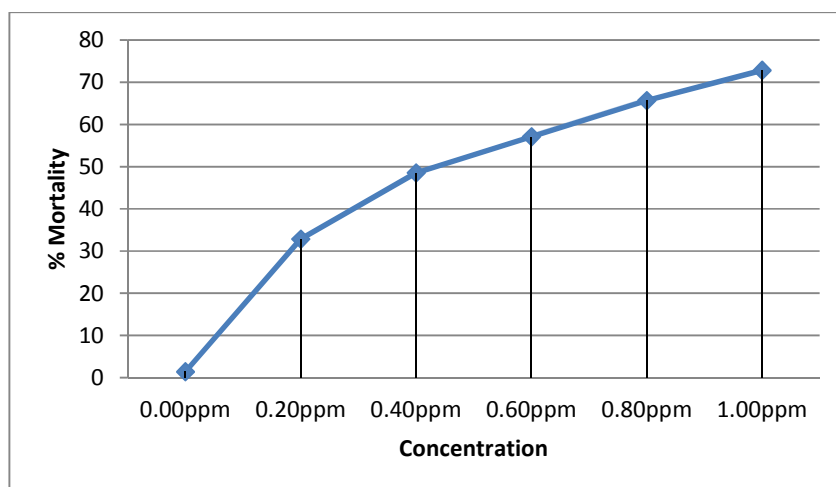


Fig. 1. Concentration-mortality rate response bioassay in *Clarias gariepinus* fingerlings exposed to 2, 3- dichlorovinyl dimethyl phosphate

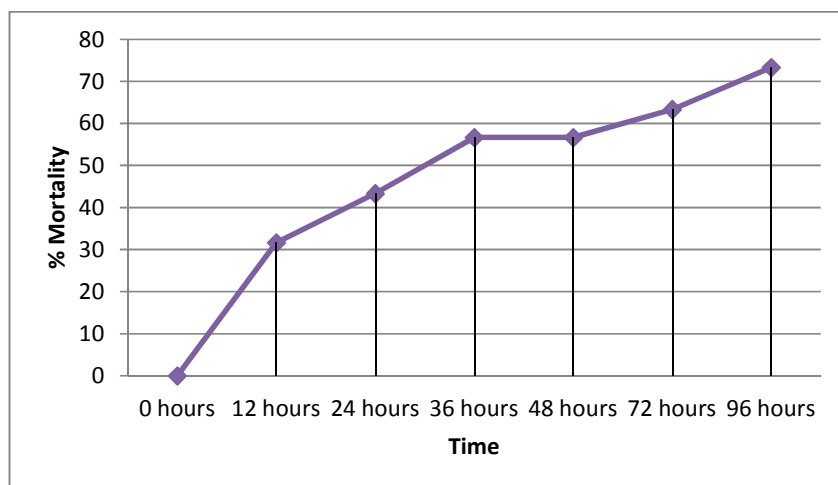


Fig. 2. Mortality-hours rate response bioassay in *Clarias gariepinus* fingerlings exposed to 2, 3- dichlorovinyl dimethyl phosphate

Typically as the concentration of the toxicant increased the mortality rate also increases. Furthermore, the increased exposure to the toxicant also affected the mortality rate. The results of this study showed that 2, 3-dichlorovinyl dimethyl phosphate is highly toxic to fingerlings of *Clarias gariepinus* even at low concentration. The absorption of 2, 3-dichlorovinyl dimethyl phosphate by the gills and/or intestinal epithelium of the fish could have led to imbalance in osmo-regulatory ability of the fish. This could have probably led to impairment in histology, histopathology, haematology, electrolytes, metabolites and enzymatic characteristics of the fishes. Due to the role of tissues and organs in metabolism and physiology in fisheries, any dysfunctioning could be highly lethal to their survival. Authors have reported that 2, 3- dichlorovinyl dimethyl phosphate is toxic [15 – 17]. Ashade et al. [16] also reported that 2,3dichlorovinyl dimethyl phosphate is highly lethal to fingerlings and affect behavioral response.

Clarias gariepinus is one the Niger Delta common wetland fish [35,36] that could thrive in both well and poorly oxygenated water [12,37]. therefore, the impart on this species of fish suggest that 2,3 dichlorovinyl dimethyl phosphate could have adverse effect on other fish species found in Niger Delta inland water ways.

4. CONCLUSION

2, 3- dichlorovinyl dimethyl phosphate containing insecticides is one of the mostly widely used

insecticides in the Nigeria Delta region of Nigeria. The remains of disused cans are frequently discarded alongside with other household and domestic wastes into the environment without any form of treatment. This study evaluated the toxicity of 2, 3- dichlorovinyl dimethyl phosphate in fingerlings of *Clarias gariepinus*, a common Niger Delta wetland fish. The study found that 2, 3- dichlorovinyl dimethyl phosphate is highly toxic to fingerlings even at low concentration. Therefore, care should be taken during the use and discarded of empty cans of 2, 3- dichlorovinyl dimethyl phosphate especially close to aquatic ecosystem.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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