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Piscicidal Potential of *Tetrapleura tetraptera* Leaf Powder on *Clarias gariepinus* (Burchell 1822) Juveniles

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Abstract

A four day acute toxicity test was conducted to determine the LC_{50} of *Tetrapleura tetraptera* leaf powder on *Clarias gariepinus* juveniles (46.68±0.62 g) following static bioassay procedures. The range finding test was carried out to ascertain the lethal concentration of the botanical on *C. gariepinus* juvenile*s* and was found to induce varying behavioral responses to the fish. The 96 h median lethal concentration was 1.60 g L^{-1} was ascertained graphically. Percentage mortality of the test fish followed a regular pattern, increasing with increasing concentration. Prior to death, fish exhibited marked behavioural changes such as hyperventilation, erratic swimming (vertical/spiral uncoordinated swimming movement), abnormal operculum and tail frequencies, forfeiture of reflex and settling at the bottom. Histological examination revealed proliferation of the mucosal cells, degeneration in the epithelium of gill filaments and severe sub-mucosal congestion particularly at the secondary lamellae at higher concentrations of *Tetrapleura tetraptera* leaf powder. The liver showed vacuolation of the hepatocyte, inflammation in the hepatocellular parenchyma and extensive portal and central venous congestion. There was also fibrosis of the port area. Lastly, the heart showed slight lesion and variation in the heart cell arrangement disintegration of heart muscles, vacuolation and degeneration of the cardiac muscle fiber at higher concentrations of *T. tetraptera* leaf powder. Dissolved oxygen (DO_2), pH and temperature values of the water were within tolerable limits for fish culture.

Keywords: *Clarias gariepinus,* piscicide, *Tetrapleura tetraptera*

1. Introduction

Fisher folks in Africa to a great extent use plants and plant products for catching fish (Fafioye et al., 2004; Neuwinger, 2004). Indiscriminate use of these natural biocides in Nigeria water bodies are now increasing at an alarming rate (Fafioye et al., 2004). Fish farmers and fisher folks haphazardly use various kinds and parts of these plants due to their narcotic, pesticidal and molluscidal properties in other to stupefy fish for easy catch, also to clean up the aquatic ecosystems off some pests (Ologe & Sogbesan, 2007). Studies have been conducted on the response of fish to some plant toxicants (Jegede & Olanrewaju, 2012; Olufayo, 2009; Fafioye et al., 2004; Wade et al., 2002; Ayuba & Ofojekwu, 2002; Ufodike & Omoregie, 1994; Omoregie & Okpanachi, 1992; Omoregie & Ufodike, 1994); but the piscicidal effect of *T. tetraptera* leaf powder on fish has not been given much attention.

Tetrapleura tetraptera is a species of flowering plant belonging to the pea family and it is native to Western Africa (Steentoft, 1988). The plant is popularly known as *Prekese* in the Twi language of Ghana (Osei-tutu et al., 2011).

Tetrapleura tetraptera belongs to the family Fabaceae, popularly referred to as Aridan in the south-western Nigeria (Aladesanmi, 2007). It is a perennial tree of about 30m in height, single stemmed and hardy. Its bark is grey-brown, smooth-rough with smooth branchlets. The flower could either be pinkish or yellow and racemes, white, while the fruit is dark brown in colour, with four airborne pods 25 x 6.5 cm. It is commonly found in the lowland forests of tropical Africa. The fruit consists of a chubby pulp with small, brownish-black seeds. The fruit has a strong aromatic odour, which is characteristic of its insect repellent property (Aladesanmi, 2007). It is used as spices and fragrance (exotic tropical scents). The leave contains active ingredients like aridanin, *tannins, flavonoids,* umbelliferone and ferulic acid (Aladesanmi, 2007). The plant is also used to drive away mosquito, as laxative and as purgative (Adewunmi et al., 1989) and it is a known molluscicide (Lekana-Douki et al., 2011; Aladesanmi, 2007; Adewunmi, 2001).

The prevalence of schistosomiasis in Nigeria has a long history (Aladesanmi, 2007) and it has been reported in most communities around man-made dams in the State of Osun and Ekiti States of Nigeria. One method of controlling this disease is by using molluscicides and the drive for the use of T. tetraptera has received increased interest basically because it is related to its availability, suitability and economic feasibility. However, in the cause of controlling schistosomiasis transmission using T. tetraptera leaf powder a lot of fish gets killed.

Clariid catfish make up the major lucrative food fish family in Africa (Adebayo & Fagbenro, 2004).

Clarias gariepinus is one of the most commonly farmed species in Nigeria (Haylor, 1992). The man characteristic of the species are the presence of arborescent air breathing organ, omnivorous feeding habit, better growth rate, better feed conversion, ability to withstand adverse environmental condition, high fecundity and ease of culture (Hecht et al., 1996). The fish is of a high demand because of its impressive quality and enhanced taste of its flesh (Sogbesan & Ugwumba, 2008). The objective of this study is therefore to ascertain the median lethal concentration of *C. gariepinus* juveniles exposed to *T. tetraptera* leaf powder toxicity during 96 hour exposure period.

2. Methods

Two hundred [superficially healthy] *C. gariepinus* juveniles of multi-sex [of matching brood stock], mean weight (46.68±0.62 g) were procured from Ministry of Agriculture, Forestry and Fisheries Resources, Alagbaka, Akure, Ondo State. They [were conveyed] live to the Fisheries Management laboratory of Ekiti State University, Ado Ekiti, Ekiti State in a 50 L capacity plastic container, half filled with pond water between 1700-1730h. They were later stocked in rectangular plastic tanks (75 x 40 x 40) cm, 60 L capacity where they were allowed to acclimatize for 7 days.

Ten *C. gariepinus* juveniles were stocked into each tank, with three replicates per treatment. *Tetrapluera tetraptera* leaves were collected along Ilokun village settlement, Ado Ekiti, Ekiti State, Nigeria, it was shade-dried at ambient temperature and pulverized into fine particle size (< 250 μm); and kept in a clean, dry, air-tight glass container. The different fish group were treated with 0.0 (controls), 1.0, 1.6, 2.2 and 2.8g *T. tetraptera* L^{-1}. Before the commencement of the experiment, the fish were fasted for 2 days. Dissolved oxygen, conductivity level, pH and Temperature were recorded using standard methods and readings were taken at interval of 24 h for 96 h. At the expiration of the treatment period, two fish from each treatment tank were removed, weighed on a Metler top-loading balance (Model P13 8001), [killed by beheading] and vital organs such as the liver, kidney and gill were taken away, fixed for 24 h in formalin-saline solution made of equal volumes of 10% formalin and 0.9% NaCl solution. Histological sections of 8 μ thickness were fixed following standard methods Chieli et al. (1995) [photomicrographs were taken using Leitz (Ortholux) microscope and camera].

3. Results

The following behaviours were displayed during the definitive test; loss of balance, respiratory distress (hyperventilation), erratic swimming (vertical/spiral uncoordinated swimming movement), abnormal operculum and tail frequencies, loss of reflex and settling at the bottom suggesting physiological stress in fish. Mortality at varying concentrations increased with increasing concentration of *T. tetraptera* leaf powder. All the fish in the control tank survived the duration of the experiment (96 hours). There was significant loss of fish with increase in *T. tetraptera* leaf powder concentration ($P < 0.05$). The LC_{50} was determined at 1.60 g leaf powder / L^{-1} of water (Figure 1). Water samples were collected [weekly] at a depth from each fibre tank. Temperature and dissolve oxygen (DO_2) were measured using glass thermometer and digital oxygen meter (YSI model 58, Yellow Spring Instrument Co) respectively. pH was measured with pH meter (Digital Mini-pH Meter, model 55, Fisher Scientific). In all the treatment groups, DO_2 concentrations decline with the increase in the concentration of *T. tetraptera* leaf powder at a range of 0.1-2.8 mg/ L^{-1}, water temperature average was 27.6 °C, pH value ranged between 6.3 and 8.6. Water quality parameters were within the suitable range for fish growth {(Environment Protection Authority, [EPA] 2003)}.

The histological alterations in the organs (gill, liver and heart) of *C. gariepinus* juveniles are presented on Table 1.

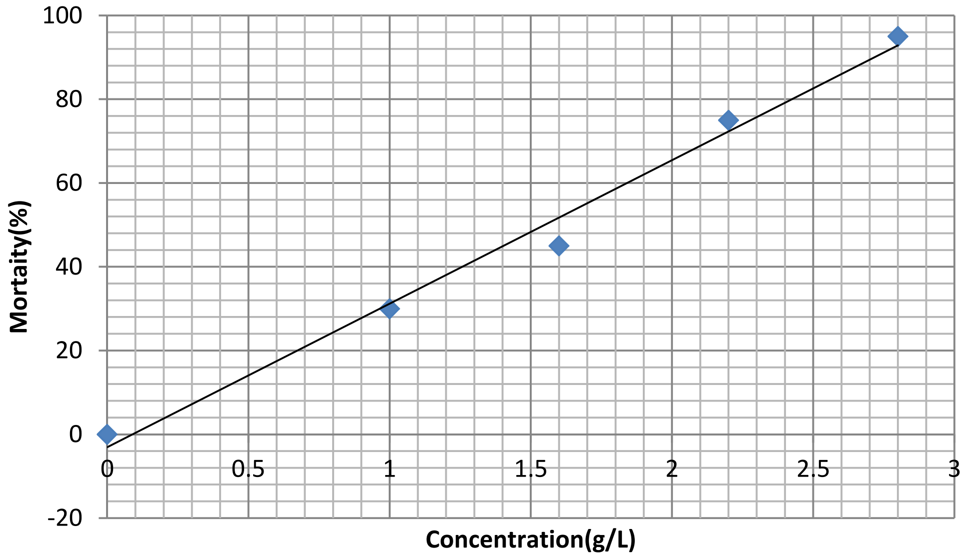

Figure 1. Effect of *Tetrapluera tetraptera* leaf powder on mortality of *Clarias gariepinus* juveniles

Table 1. Histological alterations in organs of *C. gariepinus* juveniles subjected to *Tetrapleura tetraptera* leaf

Concentration g/L	Gills	Liver	Heart
0	Normal gill architecture. No noticeable lesion seen.	Normal hepatocellular architecture and no noticeable lesion	Normal heart architecture.
1.0	No visible lesion was noticed	Evidence of slight lesion	No noticeable lesion was observed.
1.6	Proliferation of the mucus cell and congestion in the blood vessel	Vacuolation of the hepatocyte.	Slight lesion and variation in the heart cell arrangement.
2.2	Degeneration in the epithelium of gill filament	Inflammation in the hepatocellular parenchyma.	Disintegration of cardiac muscle fiber
2.8	Severe sub-mucosal congestion, especially at the secondary lamellae.	Extensive portal and central venous congestion. There is also fibrosis of the port area.	Vacuolation and degeneration of cardiac muscle fiber

4. Discussion

In this study, *C. gariepinus* juveniles exposed to *T. tetraptera* leaf powder exhibits marked behavioural changes due to physiological stress. In relevant studies (Ambedkah & Muniyan, 2009; Kori-Siakpere & Oviroh, 2011) similar behavioural changes was reported for *C. gariepinus* subjected to *Nicotiana tobaccum* leaf dust toxicity and *Channa punctatus* exposed to methanolic extract of *Capparis stylosa* respectively. Also, in a relevant study by Dan-Ologe & Sogbesan (2007), the piscicidal potential of *Euphorbia heterophylla* was tested on *Barbus occidentalis* fingerlings. The dried *E. heterophylla* stem water extract was found to induce varying behavioural response in the fish. Ayoola et al. (2011) reported agitated behaviours, respiratory distress and abnormal nervous behaviours when *Oreochromis niloticus* juveniles were exposed to aqueous and ethanolic extracts of *Ipomoea aquatica* leaf at varying concentrations.

Mortality of the test organisms (African giant catfish) fingerlings followed a regular pattern and as the concentration of *Nicotiana tobaccum* increased, mortality also increased.

Histological alterations noticed in the gill, liver and heart of *Clarias gariepinus* juveniles used in this study showed varying degrees of alterations (Tables 1). The higher the concentration of *T. tetraptera* leaf powder the more critical the adverse effects to the fish organs (gill, liver and heart). Mortalities recorded in this study could be credited to the degeneration and malfunctioning of the various organs due to the toxic effect of *T. tetraptera.* This is supported by Jegede and Olanrewaju (2012) and Fagbenro and Akinduyite (2011) in a similar studies on the piscicidal effect of *N. tobaccum* leaf dust on fingerlings of *Heterobranchus bidorsalis* and toxicity of aqueous *Morinda lucida* leaf extracts to *Oreochromis niloticus* fingerlings respectively, where the organs showed various degrees of alterations and degenerations.

5. Conclusion

This study revealed the median lethal level (LC_{50}) of *C. gariepinus* juveniles exposed to *T. tetraptera* leaf powder toxicity to be 0.60 g L^{-1}. The biocide has shown various alterations in the histology of gill, liver and heart, hence awareness of this could help in aquaculture and fisheries management by enacting policies that will discourage indiscriminate use of this plant by local fish farmers.

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