Nigerian Journal of Fisheries and Aquaculture 2(2): 24 – 29, September 2014

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Available on line: http://www.unimaid.edu.ng
ISSN-2350-1537

Toxicity of Aqueous Extracts of *Parkia biglobosa* Pods on *Clarias gariepinus* (Burchell, 1822) Juveniles

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Received, June 3, 2014 Accepted, August 26, 2014

ABSTRACT
The toxicity of aqueous extracts of *Parkia biglobosa* pods on *Clarias gariepinus* juveniles was investigated over 96hrs exposure period using the static bioassay. Fish exposed to extract of *P. biglobosa* pods exhibited respiratory distress, abnormal behaviours and death. No mortality was recorded in control fish. The 96 hrs lethal concentration 50 (LC50) value for aqueous extracts were 656.05µl/l at upper and lower confidence limit of 740.02µl/l and 582.61µl/l respectively. It was concluded that aqueous extracts of *P. biglobosa* pods are toxic to *C. gariepinus* juveniles which also impaired water quality and affect fish production.

Key Words: Acute toxicity, *Parkia biglobosa* pods, *C. gariepinus*

INTRODUCTION

Poisons are used in many parts of the world as a simple means of obtaining fish from small water bodies. In West Africa, some fifty plants are known to be used for this purpose. Some of these poisonous plants Include *Boerhaa vaccine* (Scarlet Spiderling), *Teprosia vogue* (fish bones) and *Parkia biglobosa* (Africa Locust beans) (Reed *et al.*, 1969). There are five main groups into which plant poisons can be classified with respect to their physiological activity in animals, fish inclusive. These are irritants, surface contact poisons, blood poisons, muscular poisons and nerve poisons (Reed *et al.*, 1969). Plants that are poisonous to fish have been recognized as effective alternatives to harmful synthetic compounds (Dahiya *et al*., 2000; Fafioye, 2005). A notable example of such plant pesticide is *Parkia biglobosa* which is commonly found within the savannah belt of West Africa, including Nigeria (Fafioye, 2005). *Parkia biglobosa*, which belongs to the Family *Mimosaceae*, is also widely distributed and readily available within the savannah belts of Nigeria, and one of the most common species of the parklands agro-Forestry system. Its natural range extends through the sub-Saharan, semi-arid zone from Senegal in the West through Cameroon and Sudan in the East. It is cultivated in tropical America and Western India. (Hopkins, 1983) where it is highly reputed for its medicinal and antimicrobial importance (Ajaiyeoba, 2002; Agunu *et al*., 2005; El-Mahmood; Ameh, 2007).

The plant is used traditionally to kill fish, (Jenness 1967; Fafioye, 2005).The toxicity of plants to fish is due to the phytochemical constituents normally which wears off within short time. The indiscriminate use of these plants could lead to either total fish kill in an area or makes the killed fish to become toxic to its consumers (Van Andel, 2000).

Clarias gariepinus which is hardy (Hogendoorn, 1979; Olaifa*et al*., 2003) and indigenous to Africa (Rahman *et al*., 1992) is now recognized as important tropical catfish for aquaculture within the West

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African sub-region (Clay, 1979; Anthony, 1982) including Nigeria where it is highly valued (Olaifa *et al*., 2003). This study is therefore aimed at investigating the acute toxicity of aqueous extracts of *Parkia biglobosa* pods on *Clarias gariepinus* juveniles.

MATERIALS AND METHODS

Collection and preparation of *Parkia biglobosa* pods

The husks of the pod of *P. biglobosa* was collected from the University of Agriculture, Makurdi and it environment. They were air-dried for two weeks to a constant weight under laboratory condition. The dried samples were grounded and sieved through 0.25mm, sieve. A total of 100g of the fine powder was dissolved in 500ml of distilled water as a stock solution at a room temperature ($25^oC \pm 5^oC$) for 24 hours as recommended by (Omoregie *et al*., 1998). The extract was then filtered out with filter paper (125mm) and used for the experiment.

Healthy, active juveniles of the African catfish, *Clarias gariepinus* were collected from the University of Agriculture fish farm in Makurdi for this study. The fish were transported in well aerated plastic containers to the Department of Fisheries and Aquaculture, University of Agriculture Makurdi. The fish were acclimatized in the laboratory conditions at Hatchery Complex for two weeks during which they were fed with 2mm Coppen at 5% of their body weight twice morning and evening (8:00am and 4:00pm) daily. Change of used water was done every day to avoid pollution. Unconsumed feed were syphoned.

Acute toxicity test

After acclimatization for 2 days, five (5) different concentrations (1200 µl/l, 1000 µl/l, 800 µl/l, 600 µl/l, 400 µl/l, and 0.00 µl/l) of the extracts were prepared in triplicates after a series of preliminary trail contraction tests were conducted. The 0.00ml l^{-1} served as a control for the experiments. Each of the concentrations was added to 20 litres of water in each of the plastic bowls for the experiments. Feeding was stopped 24 hours before and during the exposure, which lasted for 96 hours (UNEP, 1989).

Ten (10) juveniles of *C. gariepinus* with mean weight 28.59g ± 0.45 were exposed to the different concentrations in 18 plastic bowls of 70-L capacity and covered with a net to prevent the fish from jumping out. The whole experimental set-up was aerated continuously using many aerators (Ferrari CTB-608 double outlets). Renewal of the test media was made at every 24 hours for 4 days. The dechlorinated water from the River Benue used during the experiment had a temperature of 28.1 ±1. 0^0C. pH 7.1 ±0.5, dissolved oxygen 5.4 ±1.3 ppm and total dissolved solutes 26.0 ±5.0 ppm using Hanna, HI 9142 Meter and Hanna HI 991300 multi parameter water checker (APHA, 1985).

Fish behaviours were observed every six hours bioassay and dead fish were removed and recorded immediately from test solutions to avoid fouling the test media. The 96 hours LC_{50} was determined as probit analysis using the arithmetic method of percentage mortality data, logarithm concentration, graph and slope function, upper and lower confidence limits of the lethal concentration of 50 (LC_{50}) were determined as described by (UNEP 1989): $D = LC_{84} + LC_{50}/ LC_{50} + LC_{16}/2$. Where LC_{50}Probit value = 5.00, LC_{84}, probit value = 5.99, LC_{16} probit value = 4.01, D = the log dose concentration values, while Log_{10} D = 0.2312, Log10 $f = (2.77)/\sqrt{N}$ x Log_{10} D. Where, N = numbers of individuals tested between the range of conc corresponding to LC_{16} to LC_{84}, F = Frequency of individuals that are in the LC_{84}& LC_{16} range. N = 30+30+30+30+30, N = 150, Upper Limit = LC_{50} x f, Lower Limit = $LC_{50} \div f$ $LC_{50} = LC_{50}$ (Lower limit to Upper limit; 95% Confidence Limit).

RESULTS

The mortality of *C. gariepinus* juveniles exposed to *P. biglobosa* for 96 hours is shown in Table 1 and Figure 1. No mortality was observed in the control bowls throughout the 96 hours exposure. The LC_{50} of the aqueous extract of *P. biglobosa* pods on *C. gariepinus* juveniles over the 96 hours exposure period was

656.05µl/l with the upper and lower confidence limit of 740.02µl/l and 582.61µl/l respectively. *Clarias gariepinus* juveniles were stressed progressively with time before death. The pattern of mortalitywas similar to various concentrations of the botanical. The result of the mortality recorded for *C. gariepinus* juveniles exposed to *P. biglobosa* for 96 hours shows that at concentration of 1200µl/L, 1000 µl/L and 800µl/L, 90, 74 and 64% mortality were recorded, respectively. At concentration of 600 µl/L and 400 µl/L of 40 and 20%, respectively were recorded. There was an increase in the fish mortality with an increase in concentration of the toxicant, hence resulted in higher mortality rates.

Table 1: Mortality of *C. gariepinus* juveniles exposed to *P. biglobosa* for 96 hours

Concentration µl/l	No of Fish	Total mortality 96hr	% Mortality rate	Log of Conc.	Probit values
0.0	30.0	-	-	-	-
400.0	30.0	60.0	20.0	2.60	4.16
600.0	30.0	12.0	40.0	2.78	4.75
800.0	30.0	19.0	64.0	2.90	5.36
1000.0	30.0	22	74.0	3.00	5.64
1200.0	30.0	27.0	90.0	3.08	6.28

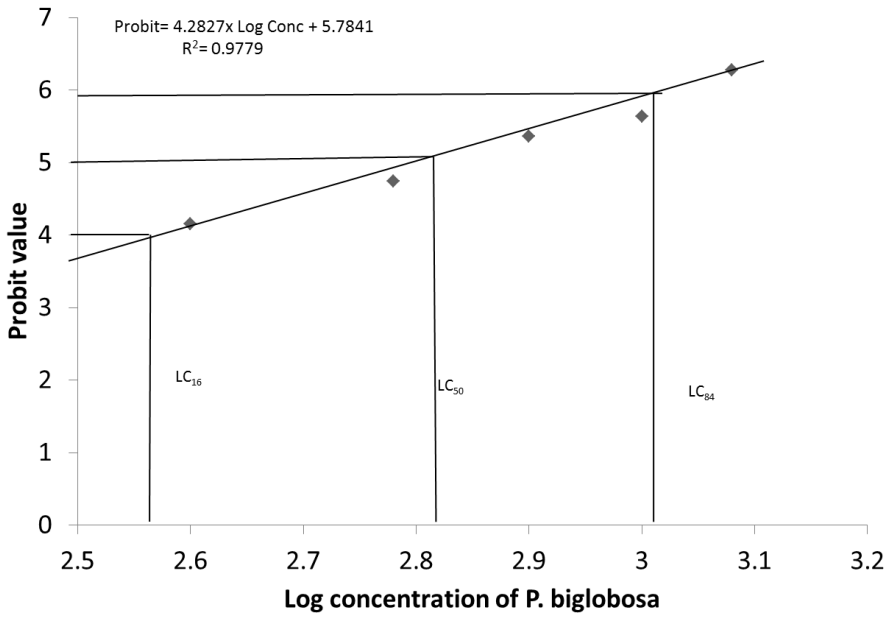

Fig. 1: Linear relationship between probit mortality and Log. concentrations of *C. gariepinus* juveniles exposed to various concentrations of *P. biglobosa* for 96 hours.

The regression equation of the relationship estimated to be probit y = 4.2827×log conc +5.7841, and on R-square value, R^2 =0.9779. The expression, R^2 value indicates that, mortality rate of fish increased with increase in concentration of *P. biglobosa* pods extract.

Table 2: Mean (± SEM) water quality parameters during the experiment

Water quality parameters	***Parkia biglobosa* Concentrations (µl/L)**				
	0.00	**400.00**	**600.00**	**800.00**	**1000.00**
Temperature (°C)	26.24± 0.15^{c}	26.27± 0.18^{b}	26.27± 0.19^{b}	26.23± 0.12^{c}	26.33± 0.12^{a}
pH	6.84 ± 0.00^{a}	6.77 ± 0.02^{b}	6.77 ± 0.02^{b}	6.68 ± 0.02^{c}	6.68 ± 0.02^{c}
Dissolved oxygen(mg^{-1})	4.53 ± 0.03^{a}	4.37 ± 0.03^{b}	4.33 ± 0.03b^{c}	4.27 ± 0.03c^{d}	4.23 ± 0.03^{d}
EC(S/m)	363.33±1.67^{f}	409.67±0.33^{e}	414.33±0.33^{d}	434.33± 0.67^{c}	472.67±0.67^{b}
TDS (ppm)	181.33 ± 0.83^{f}	204.83±0.33^{a}	207.17 ± 0.17^{d}	217.17 ± 0.33^{c}	236.17 ± 0.17^{b}

Means in the same row followed by different superscripts differ significantly ($p<0.05$).

Key: T = temperature, DO dissolved oxygen, EC = Electric conductivity, TDS = total dissolved solids

Water quality parameter during exposure of *C. gariepinus* juveniles to acute concentrations of *P. biglobosa* for 96hrs is presented in table 2. There was statistical difference ($p < 0.05$) between water quality parameters for the various concentrations.

DISCUSSION

The luck of mortality in the control group was also reported by Ayuba and Ofojekwu (2002) whom exposed *Clarias gariepinus* fingerlings to the acute toxicity of the root of Jimsons weed (*Datura innoxia*) seed extract. The concentration-dependent nature of fish mortality in this study also agreed with the work of Fafioye *et al*. (2004) who exposed *C. gariepinus* to *P. biglobosa* bark extracts. There was also an earlier report for the Africa catfish, *C. gariepinus* by Onusiruka *et al.*(1991) to be 25.71,26.92 and 8.3mg/L for the flora part of Akee apple *(Blighias apida)*, bark of Sausage plant (*Kigelia africana)* and *B. sapida*, respectively. While Orasaye and Ogbebo (1997) reported 0.4mg/l for copper sulphate on *C. gariepinus* and 105.83mg/L for toxic effects of the aqueous and ethanol extracts of *P. biglobosa* pods on *Clarias gariepinus* adults (Abalaka and Auta 2010).

The difference in the result of the present study with those of Onusiriuka *et al.* (1994) and Abalakan and Auta (2010) may be due to the differences in age, parts of the plants used (toxicants) and environmental conditions. The acute concentration of these plant extracts causes stressful behaviours such as erratic movements, gulping of air, loss of equilibrium and often death. The observed air gulping and surfacing phenomenon was an attempts by the exposed fish to cope with the increasing demand for oxygen (Schmidt *et al*., 2005). The irregular, erratic and darting movements coupled with the observed loss of balance and the adoption of different postures by the exposed fish might be due to acetylcholinesterase inhibitory effects of the *P. biglobosa* extract. This investigation agrees with the earlier work of Oti (2002), Oshode *et al*. (2008) and Ezike and Ufodike (2008), when they exposed fish to acute concentrations of different toxicants. This is similar to the result of the findings of Okomoda and Ataguba (2011). These behaviours suggest respiratory impairment, probably due to the effect of the toxicants on the gills and generally metabolism as reported by Omoniyi *et al.* (2002) and (Usman *et al.*, 20 10). Similar signs were reported in *C. gariepinus* exposed to the aqueous extract of *N. tobaccum* leaf dust (Kori-Siakpere and Oviroh, 2011). There was significant changes in the water quality parameters of the various experimental bowls, as the values observed were all within the suggested tolerance range.

Conclusion

In this study, we observed behavioural signs and deaths of exposed *C. gariepinus*juveniles including the established 96 hrs LC_{50} values for the extract implies that the aqueous extracts of *P. biglobosa* pods are toxic and therefore, can be used as effective piscicde in place of synthetic compounds to harvest fishes from our abundant water bodies.

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