Toxicity of *Jatropha curcas* to Adult and Fingerlings of nile Tilapia *oreochromis niloticus* (pisces : cichlidae)

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Absract

The toxicological effects of the seeds of *Jatropha curcas*on the behaviour and survival of the adults (41.6g-105.5g , 11.5-20cm total length) and fingerlings (6.6g-21.4g, 5.5-10.7cm total length) of Nile Tilapia (*Oreochromis niloticus*) was investigated. Fishes were exposed to varying concentration of the seed powder: 0g (control), 4g, 6g, 8g, 10g or 12g/100 ml in transparent plastic tanks for 96h under static bioassay. The results showed that, adult fish started losing reflex at 21h after the introduction of the toxicant, no loss of scale, no hemorrhage and loss of fins was observed throughout the assays. Observations on the behavioural changes of fish during the toxicity tests were recorded. The highest mortality was recorded in the fish in the highest concentration of *Jatropha* seed powder for both adults and fingerlings. Mortality In adults was 85% in 12g/100 ml concentration, 54% in 10g/100 ml, 50% in 8g/100 ml, 44% in 6g/100 ml and 34% in 4g/100 ml. In the fingerlings, mortality was 50% for 12g/100 ml, 34% for 10g/100 ml, 23% for 8g/100 ml, 27% for 6g/100 ml and 20% for 4g/100 ml. Results indicate that the fingerlings are more tolerant to *Jatropha* seed powder than the adults.

Introduction

Fish is one of the first natural resources that was exploited by man. In the developing countries fish contribute over 50% of the total animal protein and less so in the developed countries (FAO,1998). The supply of fish from natural water is faced with a lot of problems among which is the problem of environmental pollution and degradation but natural methods of environmental protections have assumed new importance in an age when environmental protection has assumed paramount importance. The immune system of aquatic organisms, such as fish, is continuously affected by periodic or unexpected changes of their environment. Adverse environmental situations may acutely or chronically stress the health of fish, altering some of their biochemical parameters and suppressing their innate and adaptive immune responses (Giro´n-Pe´rez et. al., 2007).

Jatropha curcas (Family Euphorbiaceae) contains a variety of biologically active phytochemicals such as proteins, peptides and diterpenes exhibiting a spectrum of biological activities (Devappa et al., 2010, 2011a). However, the seeds contain toxic phytochemicals called phorbol esters (PEs) (Haas et al., 2002; Devappa et al., 2011b). *J. curcas* are often used as an hedges to protect gardens and fields against roaming animals.

The Nile Tilapia, *Oreochromis niloticus* is cultured worldwide due to its characteristics such as fast growth and tolerance of poor water quality conditions . Pollution of aquatic environment can result in mass mortality of fish or their failure to breed in the polluted environment. Majority of the tropical African freshwater fishes breed naturally during the flood/rainy season which in most cases comes with increase in volume and turbidity of water. The erosion normally wash the seeds of *J. curcas* from the gardens and farm into the rivers and ponds. In this case the seed may be swallowed by adult fish or crushed by amphibians and crustaceans which assist in the release of the toxic substances such as phorbol ester, saponnis and curcins which may be responsible for the pollution of the aquatic environment.

Jatropha curcas a multipurpose plants are widely available in the tropics. Their leaves, fruits, bark and roots have economic importance for industrial and medicinal uses. In Nigeria, despite their widespread use for demarcation, garden and some medicinal purposes, their toxicity and effectiveness of the seed powder to aquatic organisms, particularly fishes, have not received much attention. The aim and objective of this study therefore, is to determine the acute and chronic toxicity of *J. curcas* seed powder on widely cultivated African freshwater fish (*O. niloticus*). The results expected from the toxicity test will provide baseline information and establish limit of using *J. curcas* seed powder in freshwater fish pond. The effect on the fingerlings and adults of *O. niloticus* will give information on the safe level on administration to the aquatic environment.

Materials and Methods

The tests were conducted under standard static bioassay procedure (Reish and Oshida 1987, APHA, 1998). The tests were conducted at the Federal University of Technology, Akure. About 200 live and healthy adult and fingerlings of *O. niloticus* measured 41.6g-105.5g, 11.5-20cm total length and fingerlings 6.6g-21.4g, 5.5-10.7cm total length were acclimated to laboratory conditions for seven days and fed to apparent satiation twice daily with a commercial pelleted fish diet containing 35% crude protein. At 48 hours prior to the commencement of the experiment, feeding was discontinued to minimize waste in the

test tank. The seed powder was prepared according to the method describe by Price (2000). A preliminary range finding test was conducted to determine the toxicity level of *J. curcas* seed powder using standard methods (APHA, 1998). The definitive test was conducted following values obtained in the range finding test, using 0g/100l, 4g/100l, 6g/100l, 8g/100l, 10g/100l and12g/100l of the seed powder. Fish mortality was monitored and recorded hourly for the first four hours, four hours for the next 24hours, and subsequently every 24 hours, for the next 96 hours. The inability of fish to respond to external stimuli was used as an index of death. Apart from monitoring and recording fish mortality, fish behaviors were also monitored.

Results and Discussion

Table1: Mortality of fingerlings and adult *Oreochromis niloticus* exposed to varying concentration of *Jatropha curcas* for 96h

Concentration (g/100ml)	No. of test animals	% Mortality	
		Fingerlings	Adults
0	30	0	0
4	30	20	34
6	30	27	44
8	30	23	50
10	30	34	54
12	30	50	84

Table2: Behaviour of *O. niloticus* fingerlings exposed to varying concentration of *Jatropha curcas* for 96h

Behaviour/ Exposure Time	24hrs	48hrs	72hrs	96hrs
Concentrations	4 6 8 10 12	4 6 8 10 12	4 6 8 10 12	4 6 8 10 12
Loss of reflex	_ _ _ _ _	_ _ _ + +	+ + + + +	+ + + + +
Air gulping	+ + + + +	+ + + + +	+ + + + +	+ + + + +
Erratic swimming	_ _ _ _ _	— _ _ _ _	_ _ _ _ _	_ _ _ _ _
Loss of scale	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _
Haemorrhage	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _

Keys: + reaction,
_ No reaction

Table3: Behavior of *O. niloticus* adults exposed to varying concentration of *Jatropha curcas* for 96h

Behavior/ Exposure Time	24hrs	48hrs	72hrs	96hrs
Concentrations	4 6 8 10 12	4 6 8 10 12	4 6 8 10 12	4 6 8 10 12
Loss of reflex	_ _ + + +	+ + + + +	+ + + + +	+ + + + +
Air gulping	+ + + + +	+ + + + +	+ + + + +	+ + + + +
Erratic swimming	_ _ _ _ _	— _ _ _ _	_ _ _ _ _	_ _ _ _ _
Loss of scale	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _
Haemorrhage	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _	_ _ _ _ _

Keys: + reaction,
_ No reaction

The result shows that the highest mortality of fingerlings when exposed to *J. curcas* for 96h(Table1) was at 12g/100ml (50%) followed by 10g/100ml (34%), 8g/100ml (23%), 6g/100ml (27%), 4g/100ml (20%) and that of the adult was also highest at 12g/100ml (84%) followed by 10g(54%), 8g/100ml (50%), 6g/100ml (44%), 4g/100ml (34%). The result shows that the fingerlings were more tolerant at the highest concentration than the adults which is in conformity with the work of Ali Gul (2004) who reported that chlorpyrifos-methyl is less toxic to Nile tilapia larvae than to most adult fish.

Although there are several reports on the effects of plants on aquatic ecosystems, no reports are available for *J. curcas* on Nile tilapia. Devappa et al. (2011b) reported that at a concentration of 0.2 mgL^{-1}, 0.3mgL^{-1}, 0.5mgL^{-1}, and1mgL^{-1},fresh water snails exhibited mortality of 25%, 43.3%, 61.1% and100%, respectively. The fingerlings started reacting to the toxicant after 24h whereas the adult have started reacting to the toxicant from 21h after the introduction of the toxicant. This agrees with the observation of Ernst et al. (2006) who studied the oral toxicity of *Planktothrix rubescens* in European whitefish, showing toxic effects from 24h after exposure. Behavioural changes are the most sensitive indication of potential toxic effects. Optomotor responses are very useful in evaluation of the behavioral changes of fish (Richmonds and Dutta, 1992). Some of the behavioral changes observed are loss of reflex, air gulping, loss of

scales and fins, haemorrhage and erratic swimming. The result in Tables 2 and 3 show that at 24h both the adult and the fingerlings started gulping for air, the adult at the highest concentration loss reflex at 21h while the fingerlings did not until 24h after the introduction of toxicant. Ayotunde et. al., (2011) in a study on the toxicity effects of *Moringa oleifera* to Nile tilapia reported behavioral changes in the fish. Although the mode of action of the seed powder of *Moringa oleifera* are markedly different from that of *J. curcas* seed powder, the behavioural changes observed are similar.

Conclusion

The widespread use of *Jatropha* plant in the farms and gardens, industries (biodiesel and soap making) and traditional uses has increased the damage incurred by these toxic compounds on the environment. From an ecotoxicological point, contamination of water sources pose a potential threat to aquatic organisms including fish. Since fish are the last chain of the food web in aquatic ecosystems there may be bioaccumulation problems in addition to acute effects. In spite of these potential risks, studies on *Jatropha curcas* in aquatic ecosystems are highly limited. The results obtained in this study clearly reveal the fact that it is necessary to carry out more toxicity studies and control uses.

References

Ali Gu¨l (2004) Investigation of acute toxicity of chlorpyrifos-methyl on Nile tilapia (*Oreochromis niloticus* L.) larvae. Chemosphere 59 (2005) 163–166

APHA, (1998) Standard Methods for the Examination of Water and Wastewater, Washington, DC.

Devappa, R.K., Makkar, H.P.S & Becker, K. (2010) Nutritional, biochemical ,and pharmaceutical potential of proteins and peptides from Jatropha: review. J. Agric. Food Chem. 58, 6543–6555

Devappa, R.K., Makkar, H.P.S. & Becker, K. (2011a) *Jatropha diterpenes* - a review. J. Am. Oil Chem. Soc. 88,301–322.

Devappa, R .K , Sanjay K. R , Vikas K, H. P. S. Makkar, & K. Becker (2011b) Activities of *Jatropha curcas* phorbol esters in var ious bioassays. Ecotoxicol. Environ. Saf. (2011), doi:10.1016/j.ecoenv.2011.11.00