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SUBLETHAL EFFECT OF METHANOL LEAVES EXTRACTS OF *KHAYA SENEGALENSIS* ON GROWTH AND FOOD UTILIZATION OF THE AFRICAN CATFISH *CLARIAS GARIAPENIUS*

O. A. ABUI[1] and M. M. MATOUKE[*2]
[1] *Federal Science and Technical College, Kafanchan, Kaduna State, Nigeria*
[2] *Federal University, Department of Biological Sciences, Dutsinma, Katsina, Nigeria, PMB 5001, Department of Biological Sciences*

Abstract

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The effect of sub-lethal concentrations 39.93 $mg.L^{-1}$, 19.97 $mg.L^{-1}$ and 9.98 $mg.L^{-1}$ of methanol leaves extract of *Khaya senegalensis* on growth and food utilization were investigated on juveniles' African catfish, *Clarias gariepinus* for a period of five months (February-June 2015). The growth rate was significantly reduced ($P < 0.05$) in fish exposed to the methanol extract *K. senegalensis* compared with the control group. Nutrient utilization showed that, specific growth rate (SGR), Feed conversion ratio (FCR), Gross feed conversion efficiency (GFCE), Feed efficiency (FE), protein efficiency ratio (PER) and Nitrogen metabolism (NM) were significant ($P < 0.05$) in the control fish compared to the exposed fish. Similarly, the percentage crude protein and oil content were significantly higher ($P < 0.05$) in the control than the exposed. The study revealed that *K. senegalensis* altered the growth and food utilization of *C. gariepinus*. Therefore the monitoring of *K. senegalensis* near productive aquatic ecosystems is recommended.

Key words: Khaya senegalensis, sublethal toxicity, growth, *Clarias gariapinus*

Introduction

The effects of pollutants on fish are evaluated by acute and chronic toxicity test (Svobodova et al, 1994, Nussey et al., 1996).

Recently, the application of medicinal plants from different families in the management of agriculture ponds has gained momentum because they are safe, effective and widely available and inexpensive (Shallender et al., 2013). Most of these plants have been reported to have a wide spectrum of biological activities capable to affect the natural environment. *K. Senegalensis* for instance, is intensively used as a shading tree and flood resistance in Northern Nigeria. This plant tree has been reported to have a toxicological effect on *C. gariepinus* (Abui and Matouke, 2015). Thus, one could imagine that the toxicological effect of exogenous compound in aquatic environment could affect the physiology and the health of animals living in that environment and more so their growth and nutrient utilization (Yaji and Auta, 2007). The authors reported the sub-lethal effects of monocrotophos a pesticide on growth and food utilization of the African catfish *Clarias gariepinus*. The growth rates were significantly reduced in fish exposed to the toxicant and nutrient utilization were significantly higher in control than exposed groups. Elsewhere, Tonye and Sokoki (2014) documented an increase of growth response and food utilization (SGR, FCE and carcass composition) of incorporated Cobalt chloride in fish diet with significant enhancement of growth.

However, pollution of freshwater bodies due to human anthropogenic activities due to chemical compound such as pesticide and metal has been plethorically reported. Toxic effect of plant tree in aquatic ecosystem including *Khaya senegalen-*

**Correspondence author*: mosesmatouke@yahoo.fr

sis still remain an environmental problem of great importance with a limited knowledge. This first study was to investigate the sub-lethal effects of *Khaya senegalensis* methanolic leaves extract on growth and food utilization of *C. gariepinus*.

Materials and Methods

Two hundred and fifty fish (250) of mean weight 18.47±3.06 g and standard length 10.9±2.7 cm fish were acclimatized in 500 L water plastic tank at 24° to 28° pond for fourteen days under natural day and night photoperiods (12/12 h) prior to commencement of the toxicity bioassay. Pond water was changed once every (3) days and were fed twice daily 5% with copen® feed containing 35% crude protein at 5% body weight. The study was conducted for a period of five months from February to June 2015.

Sub-lethal fish toxicity bioassay

Based on the results of the ninety six hours (96 h) LC_{50} reported by Abui and Matouke (2015), the sub-lethal concentrations were determined.

The sub-lethal concentrations of 39.93 $mg.L^{-1}$, 19.97 $mg.L^{-1}$ and 9.98 $mg.L^{-1}$ were obtained by using the fractions of 1/5, 1/10 and 1/20 of the result on the 96h LC_{50} respectively (OECD, 1992).

Juveniles *C. gariepinus* fish were exposed to 39.93 $mg.L^{-1}$, 19.97 $mg.L^{-1}$ and 9.98 $mg.L^{-1}$ *K. senegalensis* methanol extract for eight (8) weeks where each of the sub-lethal concentration were replicated three times and the fourth the control. A total of 120 fish species were randomly assigned to give a leading of 10 per tank. The test solution was renewed at three days interval to maintain the toxicant concentration as followed by (APHA, 1985) guideline.

Growth studies

In this study, the growth of the fish was monitored following the guideline of the OECD (1992). Ten (10) fish were randomly selected and exposed to *K. segalensis* during feeding period.

The growth measurement was recorded for 56 days so as to observe the long term effect of the extract on growth (Yaji and Auta, 2007). The fish were fed with 5% body weight twice daily with pelleted Copens® feeds for 56 days and changes in body weight were measured once every two weeks. The growth and the food utilization nutrient determination followed the method described by Amisah et al. (2009). The proximate analysis of experimental fish carcass followed the AOAC (2000) guideline.

Statistical analyses

Data expressed as mean (±SD) were subjected to Analysis of Variance (ANOVA for statistical significance ($P< 0.05$), XSTAT version 15.5 software and graph-Pad prism 6.0 were used.

Results

Growth studies

The results presented in Table 1 showed a weight gain of *C. gariepinus* in the control and a reverse gradual effect in exposed fish.

Table 1

Growth and nutrient utilization of *C. gariepinus* exposed to sub-lethal concentration of methanol leaf extract of *K. senegalensis*

	Sub-lethal concentrations ($mg.L^{-1}$)			
Parameters	0.0	39.93	19.97	9.98
Number fish	10	10	10	10
Mortality (%)	0	0	1	2
Average initial weight (g)	17.7	20.30	21.90	20.80
Average final weight (g)	25.3	27.20	27.50	22.30
Weight gain (g)	7.60^{a}	6.90^{b}	5.60^{c}	2.50^{d}
Weight gain (%)	42.9	34.0	25.6	12.0
Specific growth rate (SGR)	$27.7x10^{-4a}$	$22.8x10^{-4b}$	$17.8x10^{-4c}$	$5.36x10^{-4d}$
Feed conversion ratio (FCR)	3.21^{c}	3.24^{c}	3.40^{b}	4.06^{a}
Gross feed conversion efficiency (GFCE)	31.15^{a}	30.86^{a}	29.41^{b}	24.63^{c}
Feed efficiency (FE)	0.015^{a}	0.012^{a}	0.010^{a}	0.004^{a}
Protein efficiency ratio (PER)	0.22^{a}	0.20^{a}	0.16^{b}	0.07^{c}
Nitrogen metabolism (NM)	116.8^{a}	106.0^{b}	86.08^{ab}	34.43^{c}

Means with the same letters along row are not significantly different ($P > 0.05$)

Table 2
Proximate composition of *C. gariepinus* before and after exposure to sub-lethal concentration of methanol leaf extract of *K. senegalensis*

	Composition (%)				
		Final concentration ($mg.L^{-1}$)			
Component	Initial	0.0	39.93	19.97	9.98
Dry matter	25.30	25.88±0.67[a]	14.22±0.37[c]	16.16±0.29[b]	13.76±0.34[d]
Ash	20.43	18.49±0.06[a]	18.08±0.13[b]	17.76±0.09[c]	17.33±0.41[d]
Ether extract	39.24	37.38±0.44[a]	31.68±0.19[b]	28.10±0.17[c]	21.85±0.35[d]
Crude fibre	3.94	3.80±0.86[a]	3.41±0.23[b]	2.70±0.02[c]	2.22±0.04[d]
Nitrogen free extract (NFE)	13.10	13.9±0.15[a]	11.47±0.05[c]	11.59±0.04[b]	11.42±0.59[d]
Crude protein	72.40	77.36±0.85[a]	69.12±0.92[b]	66.48±1.24[c]	60.24±2.05[d]

Means with the same letters along row are not significantly different (P>0.05)

The specific growth rate (SGR) decreased with increased significantly ($P < 0.05$) of concentration while compared to control showing a marked reduction of growth of fish exposed to high toxicant concentration.

The Feed conversion Ratio (FCR) increased gradually with the increased methanol extract *K. senegalensis* concentrations, but no significant difference ($P > 0.05$) was observed.

The Gross feed conversion efficiency (GFCE), the feed efficiency (FE), protein efficiency ratio (PER) and nitrogen metabolism (NM) decreased significantly ($P < 0.05$) with the increased of methanol extract *K. senegalensis* concentrations when compared to control.

Table 2 showed the proximate composition of *C. gariepinus* carcass before and after exposure. The percentage of dry matter, ash, ether extract, crude fibre, Nitrogen free extract (NFE) and crude protein decreased gradually with the increased of the various concentrations significant difference ($P < 0.05$) when compared to control.

Discussion

This study observed the effect of the methanol leaf extract of *K. senegalensis* on weight gain for fifty six (56) days. The extract of *K. senegalensis* had been reported to have a toxicological effect on *C. gariepinus* exposed for ninety six hours (Abui and Matouke, 2015). The gradual reduction of weight in fish exposed to the methanolic extract might account for the long period of exposure to the toxic extract that resulted to a reduction of appetite in fish with direct consequence on the volume of food intake. This result disagree with finding of Ojha et al. (2014) on the effect of methanolic extract of *Mucuna pruriens* on growth of *Labeo rohita* fingerlings which, addition in fish diet at 0.06 g/100 g led to increase of fish *Labeo rohita.* However, *Mucuna pruriens* seed was added to the fish diet as a supplement because of its high nutritional value (Siddhuraju et al., 1996).

The reduction of growth and the significant reduction ($P < 0.05$) of nutrient utilization (SGR, FCR, GFCE, FE,PER, NM) observed in this study by the exposed fish could be due to metabolic changes caused by direct toxic stress of the methanol leaf extracts of *K. senegalensis.* The fall of these indexes could also be attributed to the reduction in food consumption which led to lost of energy which if available should be utilized for other demanding physiological and biological activities. Similar findings was reported by Yaji and Auta (2007) who study the sub-lethal effect of monocrotophos a chemical pesticide on growth and food utilization of the African Catfish *C. gariepinus*.

This study revealed a significant ($P < 0.05$) reduction in dry matter, ash, ether extract, crude fibre, nitrogen free extract and crude protein in the exposed fish compared to the control, groups. This showed that the metabolism of these compound were impaired by the *k. senegalensis* extract which suggest high utilization of the compounds for energy due to increased activity to avoid polluted water, attributing the fish condition to stress and impairment of carbohydrate metabolism. This study disagreed with the findings reported by Dada and Olugbemi (2013). Their findings showed and increased of dry matter, ash, ether extract, crude fibre, nitrogen free extract and crude protein while fed with the commercial feed.

Conclusions

This investigation shows that the exposure of *C. gariepinus* to high concentration of metabolic leaf extract of *K. senegalensis* affected its food acceptability which led to its loss in weight and growth rate respectively, therefore forestation of *K. senegalensis* near river banks should be monitored.

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