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Effects of Sub-lethal Concentration of Aqueous Extracts of Thorn Apple (*Datura stramonium)* Leaves on Weight Changes and Haematology Parameters of Fingerlings *Clarias gariepinus*

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ABSTRACT: Effects of acute and sub-lethal concentration of *Datura stramonium* on growth and some haematological indices on fingerlings of *Clarias gariepinus* were investigated. Acute lethal toxicity (LC_{50}) of *D. stramonium* leaves extracts for 48 hours exposures of *C. gariepinus* were determined at 0.2 ml/L. *Clarias gariepinus* fingerlings (4.22±0.01g) were exposed to *D. stramonium* at 0.00, 0.002, 0.02 and 0.2 ml/L for 28 days and 10 days withdrawal. Each treatment was stocked 20 fish per replicate and replicated twice. Growth indices, haematological parameters, and histology were determined. The result shows a general increase within the weight gain among the treatments but the value decreases as the concentration of *D. stramonium* increases. The haematological response to *D. stramonium* exposures was very variable relative to the exposed concentration. The result obtained after 10 days withdrawal of haematology was relatively almost like the values obtained within the control and before the experiment. Histology revealed the gills, liver and intestines of *C. gariepinus* for the control shows no lesions, while the exposed groups recorded like moderate lamellar atrophy, and moderate diffuse hepatocellular degeneration. The results indicate that the exposure to sub-lethal levels of *D. stramonium* impacted on the growth, blood profiles, and histology of the exposed fish.

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INTRODUCTION

Clarias species may be a cosmopolitan fish in Asia and Africa (Omitoyin, 2004), African catfish (*C. gariepinus*) is that the most cultured fish in Nigeria, due to its extremely popular on account of its tasty flesh, unparalleled hardness, rapid growth and high market value (Food and Agriculture Organisation, FAO, 2003). Fish is getting used as bio-indicator thanks to its sensitiveness towards water quality and thus is getting used extensively to assess the water quality of aquatic ecosystems (Whitefield and Elliott, 2002; Dautremepuits *et al.* 2004).They have been a general practice worldwide for use of toxic plants for catching fish. The ichthyotoxic characteristics of a number of these plants make them potent tools for catching or stupefying fish everywhere in the world. Local fishermen in Nigeria have reportedly used specific biocides derived from plants for fishing for four decades (Reed *et al*. 1967). Fisherfolks of varied African countries extensively use many plants and plant products for capturing fish (Neuwinger, 1994; Fafioye *et al.* 2004). Many fish poisons derived from plants from different families are wont to catch fish everywhere in the world. These poisons, also called icthyo toxins or piscicides, occur in several related plant species like *Adenia cissampeloides, Balanites aegyptiaca, D. elliptica, D. trifoliata, Kigelia Africana, Mimusops elengi, Mundulea sericea, Tetrapleura tetraptera, T. candida, T. purpurea, T. virginiana and T. vogelii* (Guerrero and Guerrero, 1989; Neuwinger, 1994; Onusiriuka and Ufodike, 1994; Andrei *et al*. 2002; Cheenpracha *et al.* 2007; Negi and Kanwal, 2009).The active ingredients of those plants are released by mashing and grinding the acceptable plant or plant parts, which are then introduced to the aquatic environment. The active principles within the plant structure used (leaves, seeds, kernel and bark) have varying potencies and modes of action counting on whether it's applied directly and therefore the sorts of extracts, aqueous or alcohol used (Sambasivam *et al.* 2003). Lethal

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and sublethal concentrations of plant poisons are known to possess toxic effects on fish behaviour, haematology, histopathology, growth, reproduction, feeding, respiration and general other physiological processes of exposed organisms. Datura species are rich in alkaloids (hyoscyamine, hyoscine, atropine, and scopolamine), saponins, flavonoids, phenols, essential oils and cardiac glycosides (Ayuba *et al.* 2011, Silva 2005, Singh and Kaushal, 2007). The active in datura is atropine and scopolamine which are utilized in traditional medicine (Ayuba *et al.* 2011). There are a couple of reports on the effect of *D. stramonium* as a biocidal agent in aquaculture. Exposure of fish to those biocides may cause stress in fish without necessarily resulting in death. The mechanism of action and its effects on indigenous fish species like *C. gariepinus* haven't been well elucidated. Hence, the choices of this study of *D. stramonium* as biocidal agents on *C. gariepinus* juveniles.

MATERIALS AND METHODS

Plant Collection and Identification: Mature leaves of *D. stramonium* were obtained from a farm in Akure, Ondo State. The plant was identified at the herbarium unit of Olusegun Agagu University of Science and Technology, Okitipupa where a voucher specimen was deposited for future reference.

Preparation of Aqueous Leaves Extracts: Two hundred grams (280g) of fresh *D. stramonium* leaves were washed with water, macerated and squeezed in 15 litres of water to get the aqueous leaves extracts and concentration of 0.2, 0.4, 0.6, 0.8 and 1.0ml of *D. stramonium* were used for 48h range-finding test.

Experimental Fish: Two hundred and fifty (250) fingerlings of *C. gariepinus* of average weight 4.22 ± 0.02g were obtained from a reknown fish farm in Okitipupa. The *C. gariepinus* were transported to the Fisheries and Aquaculture Laboratory, Olusegun Agagu University of Science and Technology, Okitipupa in a modified plastic jerry can containing sufficient water from the farm. The fish were acclimatized for 14 days and fed twice daily in the pelleted fish feed (Coppens) containing 40% crude protein.

Determination of 48 hours LC_{50} and Sub-lethal Toxicity Test: After acclimation, the extracts of the *D. stramonium* leaves were dissolved in distilled water and introduced into 16 experimental bowls (60 cm × 30 cm × 30 cm) containing dechlorinated well-aerated tap water at different concentration (0.2, 0.4, 0.6, 0.8 and 1.0ml/L) for range finding test. Fish were randomly selected and stocked at 8 *C. gariepinus* fingerlings per experimental bowl for range finding test. Twenty-four hours before the commencement of the LC_{50} range feeding test, feeding was stopped for the fish. Each of the test solutions was introduced directly into the experimental tank in a single dose and replicate twice per treatment. The behaviour and mortality of the test fish in each tank was monitored and recorded every 15 min for the first hour, once every hour for the next three hours and every four hours for the rest of the 48 hours. The 48 hours LC_{50} value was recorded and tested by probit analysis as described by Finey, (1971).

*Sub-lethal Test:*1/10th value of the resulting 48 hours LC_{50} value (0.2ml/L) was considered as sub-lethal concentration. Twenty (20) fish per treatment was exposed to the sub-lethal concentration for 28 days. Four (4) groups were exposed to different concentrations of *D. stramonium*. One group of the fish did not receive *D. stramonium* served as the control group for *C. gariepinus*. Other treatments received 0.002, 0.02 and 0.2ml/L *D. stramonium* with 35 litres of water for *C. gariepinus*. The test plant was changed every 72h and the experiment lasted for 28 days. The fish were fed at 3% body weight with 2mm Coppens. The diets per day were divided into two; 1.5% in the morning by 8.00 am and evening by 5.00pm. Measurement of the weight changes was performed every week and the feeding rate adjusted weekly according to the new bodyweight.

Histopathological Examination: Fish tissues such liver, intestine and gills from each treatment for histopathological examination at Histopathology Unit of Veterinary Pathology Department, University of Ibadan Nigeria. After the experiment, fish from both the exposed and control group was dissected, the gill, intestine and liver were carefully removed and washed in 0.9% saline and fixed in 10% formalin in heparinized bottles (without EDTA).These organs were sections and staining as described by the modified methods of Rodrigues, (2007) and Omitoyin *et al.* (2006). A light photomicroscope attached to a 35 mm camera was used to examine the organs sections.

Haematological and Biochemical Assessment: Blood samples (5 ml) was collected before the experiment and at the end of the experiment (day 28) and 10 days after withdraw (to assess physiology recovery of fish) from the caudal peduncle of both the exposed and control fish into heparin bottles (with EDTA) and transported in ice packed to the Microbiological Laboratory unit of Ondo State Specialist Hospital,

Okitipupa for the analysis of complete haematology using standard methods as described by Dacie and Lewis, (1991).

Plasma and Serum Biochemistry: Blood samples were centrifuged at 3000 rpm for 15 minutes to obtain serum biochemical parameters. Serum from the centrifuged blood was carefully siphoned out and the concentration of Glucose, total proteins, albumin and globulin were estimated as described by Dacie and Lewis, (1991).

Biological Evaluation: The weight of the test animals in treated and untreated (control) groups were recorded at the commencement and after the experiment (28 days) of the sub-lethal test. Weight changes in the fishes were carried out every week of the experiments to reduce the introduction of handling stress in the test animals. This was done with the aid of a battery-operated weighing scale and the following biological evaluation was measured as Weight gain = Final Body Weight – Initial Body Weight, Percentage weight gain = (Final Body Weight – Initial Body Weight) / Initial Body Weight × 100**,** Specific Growth Rate (SGR) = 100 (loge FBW – loge IBW) / Time**,** Feed Conversion Ratio (FCR) = Dry weight of the feed / Fish weight gain**,** Nitrogen Metabolism (NM) = 100 (number of fish stocked - Mortality) / Number of Fish Stocked**,** Survival Rate (SR) = Initial number of fish stoked – Mentality/Initial number of fish stoked x100**,** Nitrogen metabolism = (0.549)(a+b)h/ 2**,** where, a = Initial mean weight of fish b = Final mean weight of fish**,** h = Experimental periods in days (Nwanna 2003).

Statistical Analysis: Data obtained were subjected to one-way analysis of variance (ANOVA) while the means were compared for significant differences using the Duncan test.

RESULTS AND DISCUSSION

Behavioral Responses to Toxicity of D. stramonium: During the range-finding test the following observations were observed in the exposed fish; loss of appetite, erratic movement, restlessness, frequent opercula movements, state of motionlessness, mucus secretion, adoption of different postures, swirling movements, loss of reflex and loss of balance.

Growth performance and nutrient utilization of Clarias gariepinus: The control treatment has the highest body weight gain (11.21 ± 2.39) and lowest in TAL4 (3.72 ± 0.301). The highest numerical value for nitrogen metabolism (NM) was recorded in the control and the lowest value in TAL4 of 151.00 ± 18.49 and 93.47 ± 2.31 respectively. Generally, the control treatment shows better performance in all the parameters apart from the survival rate, which is optimum in TAL3 and TAL4. The survival rate was better in the treated groups compared to the control. There was no significant difference (P>0.05) among the dietary groups (see Table 1).

Table1: Growth performance and Nutrient Utilization of *C. gariepinus* fed *D stramonium* for 28 days

Parameters	Control (0 ml/L)	TAL2 (0.002 ml/L)	TAL3 (0.02 ml/L)	TAL4 (0.2 ml/L)
Initial Weight (g)	4.22±0.01^{a}	4.22±0.00^{a}	4.22±0.00^{a}	4.22±0.00^{a}
Final Weight (g)	15.43±3.39^{b}	13.08±0.04^{b}	13.04±0.23^{b}	7.93±0.43^{a}
weight gain (g)	11.21 ± 3.39^{b}	8.86±0.00^{b}	8.82±0.23^{b}	3.71±0.43^{a}
Weight Gain (%)	265.64±79.87^{b}	209.95±1.17^{b}	209.00±5.18^{b}	87.91±10.10^{a}
Specific Growth Rate	1.19±0.35^{b}	1.76±0.01^{b}	1.75±0.03^{b}	0.98±0.08^{a}
Feed Conversion Rate	1.60±0.48^{a}	1.50±0.00^{a}	1.45±0.04^{a}	3.41±0.39^{b}
Survival Rate (%)	95.00±0.00^{a}	95.00±7.07^{a}	97.50±3.53^{a}	97.50±3.53^{a}
Nitrogen Metabolism	151.00±26.14^{b}	133.20±1.09^{b}	132.66±0.11^{b}	93.47±3.26^{a}

Key: Mean of duplicate data, mean value in each row with similar superscripts are not significantly different (P > 0.05)

Mean Haematological Parameter of Clarias gariepinus on Sublethal Concentration of D. stramonium Leaves Extracts: There was an increase in the value of some haematological parameters among the treatments. TAL 4 recorded the highest values in PCV, HB, MCV and neutrophils when compared to the control. There was no significant difference (P > 0.05) in PVC, HB, RBC, WBC, NEU, lymphocytes and monocytes. The withdrawal reading was recorded to be decreasing among the treatments on PVC, HB and LYMP compare to the sublethal effect of *D. stramonium* and increase of values was recorded in WBC, MCHC and Eosinophils (Table2).

Mean plasma biochemistry parameter of C. gariepinus on the sub-lethal concentration of D. stramonium leaves extracts: The result shows that the values obtained in the TP, ALB were generally increased in the treated groups when compared to the values obtained in the control and they were significantly different (P > 0.05) among the treatments. The values of globulin obtained showed that the control had higher values than the exposure groups and there were significant differences (P > 0.05) among the treatments. The values obtained after 10 days withdrawal revealed decrease values compared to the value obtained before the experiment and the value

recorded in control after 10 days exposure (Table 3).

Mean blood serum parameter of C. gariepinus on the sub-lethal concentration of D. stramonium leaves extracts: There was no significant difference (P >0.05) in all parameters at both the withdrawal and the test in ALT, AST and Glucose. The values recorded in the exposure groups were lower than the value recorded in the control. The result of the withdrawal shows that the values were lower in AST and ALT when compared with the control of withdrawal (Table 4).

Histological parameter of C. gariepinus on the sub-lethal concentration of D. stramonium leaves extract: There are no observable lesions in the experimental organs (gills, liver and intestine) in the control and at TAL4. There are slight observable changes in the organs at TAL2 and TAL3. Photomicrograph is shown below (Plate 1A-1C)

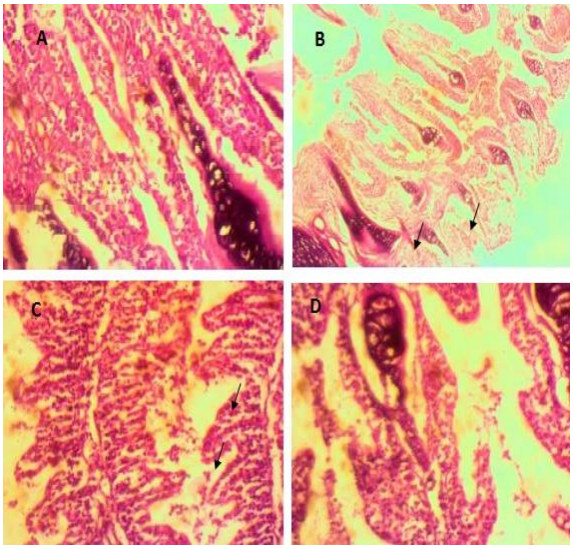

Plate 1 (A – D): Photomicrograph showing a transverse section of gill filaments of *Clarias gariepinus* fingerlings. (**A**) Control showing there is no observable lesion (**B**) Gill of exposed at 0.002ml/L indicating there is moderate lamellae atrophy (arrows) (**C**) Gill of exposed at 0.02ml/L indicating there is moderate pilar congestion and sloughing of lamellar cells (arrows) (**D**) Gill of exposed at 0. 2ml/L showing there is no observable lesion. HE x400

The results of the study revealed that behavioural abnormalities such as erratic movement, restlessness, frequent opercula movements, state of motionlessness, mucus secretion, adoption of different postures, swirling movements, loss of reflex and loss of balance are attributed to respiratory impairment, resulting from the effects of the toxicant on the organs of the exposed fish. This result was similar to the report of Essien-Ibok *et al*. 2019. The result of this experiment revealed that there is a general increase among the treatments. The weight gain was highest in the control diet compared to the exposed groups. It was observed that the weight decreases as the exposure concentration increases and there were significantly different (P< 0.05) among the treatments. The result of the experiment shows that survival growth rate (SGR), feed conversion ratio (FCR) and nitrogen metabolism (NM) was higher in the control diet compared to the other treatments exposed to *D. stramonium* at different concentration and there were significant differences (P< 0.05) among the treatments.

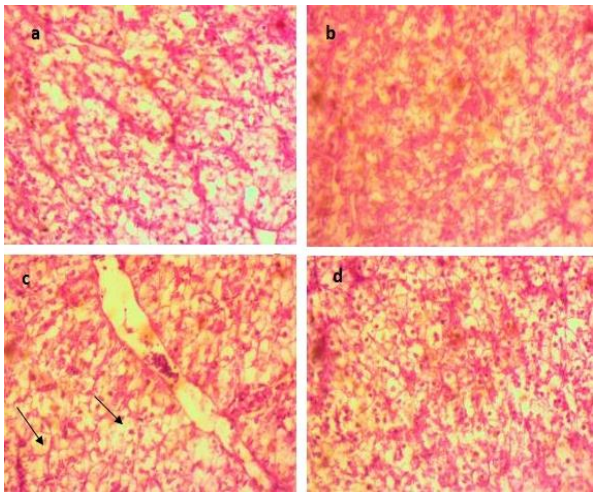

Plate 2 (A – D): Photomicrograph showing a transverse section of the liver of *Clarias gariepinus* fingerlings. (**A**) Control showing there is no observable lesion (**B**) Liver of exposed at 0.002ml/L indicating there is no observable lesion (**C**) Liver of exposed at 0.02ml/L indicating there is moderate diffuse hepatocellular degeneration (arrows). (**D**) Liver of exposed at 0. 2ml/L showing there is no observable lesion. HE x400

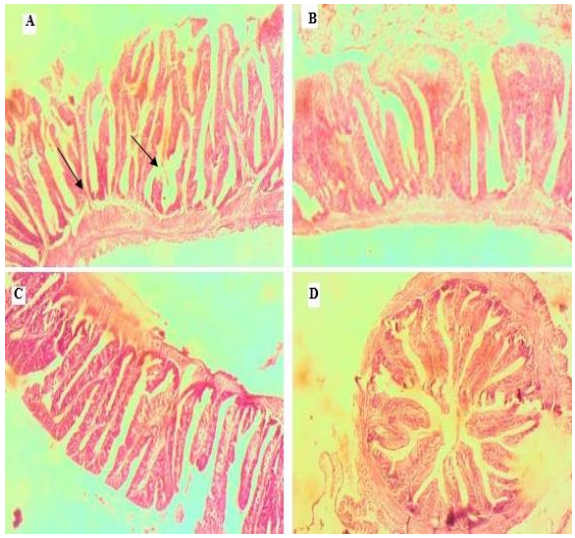

Plate 3 (A – D): Photomicrograph showing a transverse section of the intestine of *Clarias gariepinus* fingerlings. (**A**) Control showing there is no observable lesion (**B**) Intestine of exposed at 0.002ml/L indicating there is no observable lesion (**C**) Intestine of exposed at 0.02ml/L indicating there is no observable lesion (**D**) Intestine of exposed at 0. 2ml/L showing there is no observable lesion. HE x400

Table 2: Mean haematological parameter of *C. gariepinus* before, after exposure to different concentrations of *D. stramonium* for 28 days and 10 days withdrawal period

Parameter	Before	28 days of exposure				10 days withdrawal period			
		Control (0 ml/L)	TAL2 (0.002 ml/L)	TAL3 (0.02 ml/L)	TAL4 (0.2 ml/L)	Control (0 ml/L)	TAL2 (0.002 ml/L)	TAL3 (0.02 ml/L)	TAL4 (0.2 ml/L)
PVC%	40.00 ±2.28^{a}	40.00 ±2.28^{a}	42.00±3.28^{a}	41.00±2.28^{a}	43.00±2.28^{a}	40.00±2.23^{a}	42.00±2.28^{a}	41.00±2.23^{a}	41.00±2.23^{a}
HB(g/dl)	13.30±0.28^{a}	13.30±0.28^{a}	13.00±2.28^{a}	13.00±0.28^{a}	14.30±0.28^{a}	14.00±0.28^{a}	14.30±0.28^{a}	13.7±0.28^{a}	13.70±0.28^{a}
RBCx10$^{12/l}$	5.00 ±0.28^{a}	4.70±0.28^{a}	4.60±0.28^{a}	4.80±0.28^{a}	4.90±0.28^{a}	4.70±0.3^{a}	4.20±0.30^{a}	4.50±0.30^{a}	4.30±0.30^{a}
WBCx10a/l	10.40±0.28^{a}	11.00±2.82^{a}	11.80±0.82^{a}	11.80±0.28^{a}	10.80±0.28^{a}	10.80±0.3^{a}	11.40±0.30^{ab}	11.60±0.30^{ab}	11.70±0.30^{b}
Platelet(m/µl)	28.50±0.28^{ab}	28.90±0.28^{b}	29.80±0.28^{c}	30.10±0.28^{c}	28.10±0.28^{a}	29.40±0.28^{b}	28.70±0.28^{a}	29.80±0.28^{b}	28.60±0.28^{a}
MCV (F1)	80.00 ±0.28^{a}	85.10±0.28^{b}	91.30±0.28^{c}	85.40±0.28^{b}	87.80±0.28^{b}	89.40±0.28^{a}	104.20±0.28^{d}	91.40±0.28^{a}	95.40±0.28^{c}
MCH(pg/cal)	26.60±0.20^{a}	28.38±0.20^{b}	30.40±0.20^{d}	28.50±0.20^{bc}	29.20±0.20^{c}	34.80±0.79^{ab}	34.10±0.30^{ab}	30.40±0.28^{a}	40.40±0.79^{b}
MCHC (g/dl)	38.30±0.28^{b}	33.30±0.28^{a}	33.30±0.28^{a}	38.40±0.28^{b}	33.30±0.28^{a}	33.30±0.28^{a}	33.30±0.28^{a}	33.40±0.28^{a}	33.40±0.82^{a}
NEU (%)	65.00±2.82^{a}	65.50±2.12^{a}	70.00±2.82^{a}	65.00±2.83^{a}	68.00±2.83^{a}	67.00±2.83^{a}	70.00±2.83^{a}	64.00±2.83^{a}	68.00±2.83^{a}
LYMP (%)	32.00±2.82^{a}	32.00±2.82^{a}	30.00±2.82^{a}	32.00±2.82^{a}	30.00±2.82^{a}	31.00±2.83^{a}	30.00±2.83^{a}	31.00±2.83^{a}	29.00±2.83^{a}
MONO (%)	2.00±2.80^{a}	1.00±0.28^{a}	0.00±0.00^{a}	2.00±2.83^{a}	2.00±2.83^{a}	0.00±0.00^{a}	0.00±0.00^{a}	4.00±2.83^{b}	2.00±2.83^{a}
EOS (%)	1.00±0.28^{b}	0.00±0.00^{b}	0.00±0.00^{a}	1.00±0.28^{b}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	1.00±0.30^{b}	1.00±0.30^{b}

Keys: TAL= Thorn Apple Leaves, PVC= Packed Cell Volume, HB= Heamoglobin, RBC= Red Blood Cell, WBC= White Blood Cell, MCV= Mean Cell Volume, MCH= Mean Cell Heamoglobin, MCHC= Mean Cell Heamoglobin Concentration, LYMP= Lymphocytes, MONO= Monocytes, EOS= Eosinophil. Mean of duplicate data, mean value in each row with similar superscripts are not significantly different (p>0,05)

Table 3: Mean Plasma Biochemistry parameter of *C. gariepinus* fingerlings before and after exposure to different concentration of *D. stramonium*

Parameter	28 DAYS EXPOSURE					10 DAYS WITHDRAWAL PERIOD			
	Before	Control (0)	TAL2 (0.002 ml/L)	TAL3 (0.02 ml/L)	TAL4 (0.2 ml/L)	Control (0)	TAL2 (0.002 ml/L)	TAL3 (0.02 ml/L)	TAL4 (0.2 ml/L)
TP (g/dl)	72.00±2.20^{a}	72.00±0.83^{a}	75.00±2.20^{a}	78.00±2.83^{a}	76.00±2.20^{a}	72.00±2.83^{a}	70.00±2.83^{a}	76.00±2.83^{a}	70.00±2.83^{a}
ALB (g/dl)	34.00±0.82^{a}	37.00±2.83^{a}	38.00±2.82^{a}	35.00±2.82^{a}	39.00±2.83^{a}	35.00±2.83^{a}	38.00±2.83^{a}	38.00±2.83^{a}	34.00±2.83^{a}
GLO(g/dl)	38.00±0.38^{ab}	35.00±0.28^{a}	37.00±1.82^{ab}	43.00±0.80^{b}	37.00±0.80^{ab}	37.00±2.80^{a}	35.00±2.80^{a}	38.00±2.80^{a}	36.00±2.80^{a}
ALB/GLO Ratio	0.90±0.28^{b}	1.10±0.28^{b}	1.00±0.28^{b}	0.00±.00^{b}	1.10±0.80^{b}	1.00±0.30^{a}	1.10±0.30^{a}	1.00±0.30^{a}	0.90±0.30^{a}

KEYS: TAL=Thorn Apple Leaves, TP= Total Protein, ALB= Albumin, GLO= Globulin, ALB/GLO= Albumin-Globulin ratio. Mean of duplicate data, the mean value in each row with similar superscripts are not significantly different (P >0.05).

Table 4: Mean blood serum biochemistry parameter of *C. gariepinus* fingerlings before and after exposure to different concentration of *D. stramonium*

Parameter	28 Days Exposure					10 Days Withdrawal Period			
	Before	Control (0)	TAL2 (0.002 ml/L)	TAL3 (0.02 ml/L)	TAL4 (0.2 ml/L)	Control (0)	TAL2 (0.002 ml/L)	TAL3 (0.02ml/L)	TAL4 (0.2 ml/L)
ALT (iu/l)	10.00±0.83^{a}	12.00±2.82^{a}	10.00±2.82^{a}	11.00±0.83^{a}	10.00±2.83^{a}	12.00±2.83^{a}	11.00±2.83^{a}	10.00±2.83^{a}	10.00±2.83^{a}
AST (iu/l)	12.00±0.82^{a}	13.00±2.80^{a}	12.00±0.83^{a}	13.00±0.82^{a}	8.00±0.82^{a}	14.00±2.82^{a}	13.00±2.82^{a}	13.00±2.82^{a}	15.00±2.82^{a}
GLU (mol/l)	4.80±0.28^{a}	4.80±2.83^{a}	4.60±0.82^{a}	5.00±2.81^{a}	4.00±0.82^{a}	4.30±0.30^{a}	4.70±0.30^{a}	4.70±0.30^{a}	4.00±0.30^{a}

Keys: TAL= Thorn Apple Leaves, ALT= Amino alanine transferase, AST= Aspartate aminotransferase, GLU= Glucose. Mean of duplicate data, the mean value in each row with similar superscripts are not significantly different (p>0.05).

This result was in accord with the report of Lawee and Imgbian, (2017) who reported the decrease in mean weight gain, and SGR of *C. gariepinus* exposed to different concentrations of bonthazon and significant reduction were observed as the concentration of bonthazon increases which was similar to this finding. The highest value recorded in the control could be due to the absence of *D. stramonium* leaves extract concentration in the water. This result of the present study was similar to the report of Fafiolu *et al.* (2006) who also reported a decrease in body weight gain in exposed groups compared to control. The results of haematological parameters such as PVC, HB, RBC and WBC were not significantly different (P> 0.05) among the treatments. The exposed had the higher value than the control group in PVC, HB, RBC, WBC and NEU were higher in the exposed groups except for TAL3 who recorded similar value with the control and value obtained before the experiment. However, the decrease in the value of HB and RBC observed in this report when compared to the values obtained before the experiment was similar to the report of Lawee and Imgbian, (2017) who reported a decrease in values of haemoglobin and red blood cell on juveniles *C. gariepinus* fed different concentrations of bonthazon. Reduction in values of PVC, HB and RBC after exposure to different concentrations of *D. stramonium* reflects an anaemic condition resulting from haemodilution and impairs osmoregulation across the gill epithelia (Sanpath *et al.* 1993).

The NEU and MONO value obtained was higher than that of the control and this was in agreement with the report of Lawee and Imgbian, (2017), the increase in MONO and NEU could be correlated with the increase in antibody product which help in the survival and recovery in fish exposed to sublethal concentration of *D. stramonium*. This finding suggests the sensitivity of MONO, NEU and LYMP to *D. stramonium* leaves. After 10 days withdrawal period it was observed that as the concentration increases the value decreases in PVC, HBC and RBC among the exposed groups compared to the control. However, the value obtained in NEU and MONO after 10 days exposures shows an increase in the value of *D. stramonium* exposed to different concentration compared to the control. The reason for this might be that enough oxygen transportation was observed in the fish exposed to the toxicant which implies the general well-being of the exposed fish.

The observation could be due to immunological reaction leading to antibody production to cope with the stress in this by the toxicant. The result of the study revealed that TP, ALB and GLO were generally increased among the treatments. There were no significant different (P>0.05) except GLO who record significant difference (P<0.05) among the treatment. This result was in agreement with the report of Cimanga, (2018) who reported an increase in TP, ALB and GLO of *C. gariepinus* exposed to sub-acute toxicity of aqueous extract of *C. sanguinolenta* root bark. The values of total protein, globulin and albumin recorded after 10 days withdrawal show relative similar values to the one obtained before the experiment, control of 28 days exposure and the control of 10 days after withdrawal and no significant different (P > 0.05) among these parameters of the exposed groups and the control. There are a general increase in ALT, AST and decrease were observed in the glucose except for TAL3, who recorded higher value obtained in TAL3 compared with the control and other treated groups. This report was in accord with the report of Cimanga, (2018) who reported an increase in ALT, AST of fish exposed to different concentrations of *Crytolepis sanguinolenta.* There were general decreases in the value obtained after 10 days withdrawal period in the parameters compared with the control. This might be due to oxygen availability absorbed in the diet taken and there were no significant different (P>0.05) among all the treatments. The result of histology on gills, liver and intestine revealed that there were no observable lesions in the control for gills, liver and intestine while moderate lamilae atrophy was observed in the gills of the fish exposed to 0.002 of *D. stramonium*. Moderate pillar congestion and sloughing of lamillar were observed in the control at 0.02 ml/L concentration. There were no observable lesions were observed in the control at 0.2 ml/L concentration of *D. stramonium.* Moderate diffuse hepatocellular degeneration was observed in the liver of the fish exposed to 0.02 ml/L concentration of *D. stramonium* while the control and 0.002 and 0.02 ml/L did not show any size of observable lesions. In the intestine, no observable lesions were observed across the treatments. This result supports the work of Olurin *et al*. (2016) who reported no visible lesion in the control for gills, kidney, liver and intestine of *C. gariepinus* exposed different concentration of aluminium phosphide (phostoxin) compared to the exposed groups with mild changes in these tissues.

Conclusion: This present study strongly suggests that *D. stramonium* impacted on the growth, blood parameters and the tissues (histology) of *C. gariepinus*. Hence, continuous and unchecked exposure of fish to *D. stramonium* may greatly impair its growth and yield. However, from this study, it was observed that the higher the concentration of *D. stramonium* induced greater impact on *C. gariepinus* fingerlings than lower concentration.

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