



Physiological Responses of *Tilapia Zillii* Fingerlings following Acute Exposure to Aqueous Extract of *Lawsonia innermis* Henna Leaf

Yusuf Sulaiman^{1*}, Abdulqadir Saidu² and Adamu Muhammad Kamaludeen³

¹Department of Zoology, Nasarawa State University, Keffi, Nasarawa State, Nigeria.

²Department of Science education, Faculty of Technology Education, Abubakar Tafawabalewa University, Bauchi, Nigeria.

³Federal University of Kashere, Gombe State, Nigeria.

*Corresponding Author

Yusuf Sulaiman

Article History

Received: 10.01.2025

Accepted: 04.03.2026

Published: 26.03.2026

Abstract: - One of the most frequently obnoxious fishing practices in Nigeria water bodies is the indiscriminate use of toxic plant materials in catching fish, *Lawsonia inermis* leaves extract has been a potent fish poison used by artisanal fishermen. There is dearth of report on the toxic potential of *I. inermis* on the physiology of *T. zillii*. This study investigated the 96hr, acute toxicity of *L. inermis* leaves and its consequences on the haematological and biochemical parameters of *Tilapia zillii* fingerlings in a static bioassay. Definitive concentrations of 0.00 (control), 0.20, 0.30, 0.40, 0.50 and 0.60 g/L of *I. inermis* extract were used. Ten fingerlings (n=10) were stocked in each of the experimental tanks. The 96hr LC₅₀ of *L. inermis* on *T. zillii* was 0.38 g/L. With the exception of the significant alterations (p<0.05) in white blood cells count, there was no significant changes (p>0.05) in the levels of other haematological parameters (packed cell volume, red blood cells, haemoglobin concentration, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration and differential counts) compared with the control. There was a significant concentration dependent elevation in the levels of biochemical parameters; alkaline phosphatase, aspartate aminotransferase, alanine aminotransferase, total protein, albumin, high density lipoproteins, low density lipoproteins and lactate dehydrogenase relative to the control. The result of the present investigation revealed that crude leaves extract of *I. inermis* has detrimental effects on survival, haematology and biochemistry of the *T. zillii* fingerlings. The use of *I. inermis* to harvest fish in aquatic systems should, therefore, be discouraged.

Keywords: Acute concentration, Henna, Tilapia fingerlings, Blood cells, Enzymes.



This is an open access article under the [CC BY-NC](https://creativecommons.org/licenses/by-nc/4.0/) license



Cite this article:

Sulaiman, Y., Saidu, A., and Kamaludeen, A. M., (2026). Physiological Responses of *Tilapia Zillii* Fingerlings following Acute Exposure to Aqueous Extract of *Lawsonia innermis* Henna Leaf. *ISAR Journal of Medical and Pharmaceutical Sciences*, 4(3), 20-29.

INTRODUCTION

Different parts of plant (root, stem, leave and fruit) are used indiscriminately in catching fish in Nigeria [1] and other parts of the world. Botanicals pesticides are more preferable than synthetic [2] because they are readily available, cheap and abundant in nature. The occurrence of utilizing pesticides to start off traditional fish catches is not friendly to the habitat of aquatic biota [3].

Extracts of many botanicals such as *Deris elliptica*, *D. trifoliata*, *Adenia cissamploides*, *Balances aegyptiaca*, *Tephrosia Candida*, *T. vogelii*, *Parkia folicoides* contain phytochemicals which have traditionally been used in different parts of the world to catch fish [4]. The direct and indirect introduction of xenobiotics into water bodies amassed to nonlethal effect on organisms, but could be deleterious to fish [5]. Botanicals are discouraged for fishing because they are perilous to aquatic organisms and degrade aquatic environment [5],

Lawsonia inermis commonly known as Henna (Family: Lythraceae) is a perennial shrub, originated from North Africa [6]. It is a much-branched, glabrous shrub or small tree, 2-6m tall, with grayish-brown bark [7]. Leaves are 1.3-3.2 by 0.6-1.6cm, elliptic or broadly lanceolate with short petioles (Borade, Kale and Shete [8]. *L. inermis* is a common plant in Northern Nigeria. It is popularly called 'Lalle' in Hausa language. Beside the cosmetic properties of *L. inermis* [9], it has been traditionally reported to cure ailments such as headache, hemicranias, lumbago, bronchitis, boils, ophthalmia, syphilis in man and also has sedative effects on fish [10]. Anthelmintics properties of leaves of *L. inermis* plant have also been reported [11].

Studies conducted by [12] revealed that crude leaves extract of *L. innermis* contains active ingredients (alkaloid, tannin, saponins, cardiac glycosides and resins) responsible for sedating as well as causing adverse effects on opercula ventilation rate and survival of *T. zillii* fingerlings. Aqueous roots extracts of the *L. inermis* induced spontaneous abortion with slight toxic effects to Wister rats [13]. Acute toxicity of ethanolic extract of *L. inermis* leaves has been reported that the plant is not toxic to Albino wister rats with no histopathological and biochemical changes compared with the control [14].

Acute toxicity tests provide information on the dose that cause a notable reaction in 50% of animals exposed [6]. Aquatic toxicity tests were carried out on both microscopic and macroscopic aquatic organisms. In aquatic food cycle, fish which is last [15], has the potential to bioaccumulate toxin. Tilapia are surface feeding omnivores that grow and mature quickly, breed naturally and most common fish species in Nigeria [16].

Many renowned authors have examined toxicity effects of different plant extracts on varied fish species across the globe. Plants substances used in harvesting fish have unfavourable effects on physiology offish [17]. Haematological changes compared with the control on freshwater catfish, *Heteropneustes fossilis* exposed to lethal concentrations of *Terminalia arjuna* bark extract was reported [18]. Acute concentrations of aqueous crude leaf extract of *Balanites aegyptiaca* have showed significant changes on haematology and serum biochemistry of *Oreochromis niloticus* finger-lings [19]. Alteration in the levels of haematological and biochemical parameters of *C. gariepinus* exposed to sublethal concentrations of cassava effluent was documented [20]. Haematological and serum biochemistry alteration of *C. gariepinus*, exposed to sublethal concentrations of cold water fresh root bark extracts of *Plumbago zeylanica* (Leadwort) was documented by [21]. Changes in haematological parameters of *C. gariepinus* exposed to century plant (*Agava americana*) leaf dust was also reported [22]. Biochemical parameters changes of common Carp (*Cyprinus carpio*) exposed to aqueous crude leaves extract of *Cannabis sativa* was also documented by [23]. *Lawsonia inermis* is one of the plants used as fish poison in Nigeria however there is paucity of documented reports on its adverse effects on the physiology of common fish species like *T. zillii*.

This study investigated the physiological responses of *T. zillii* fingerlings to acute concentrations of *L. inermis* with a view to establishing toxic effects of *L. inermis* on haematology and biochemistry of *T. zillii*.

2. Materials and Methods

2.1 Samples

2.1.1 Collection and Preparation of *L. inermis* Leaves

Fresh leaves of *L. inermis* from Dull, Tafawa Balewa Local Government Area of Bauchi State, Nigeria were hand plucked and shade dried at University of Jos, Jos, Nigeria. The plant was authenticated at herbarium of Plant Science and Technology Department of University of Jos. The dried leaves were pulverized using laboratory pestle and mortar into fine powder (30µm).

2. 1. 2 Collection and Acclimatization of Experimental Fish (*Tilctpia zillii*)

A total of 120 mixed sex *T. zillii* fingerlings (mean weight 42.64 ± 0.82 g and total length 11.14 ± 0.22 cm) were purchased from Panyam Fish Farm, Mangu Local Government Area of Plateau State, Nigeria and transported to Hydrobiology and Fisheries Laboratory Unit of University of Jos in two oxygenated polythene bags (60 fingerlings per bag) containing the pond water. Fingerlings were acclimatized to laboratory condition in 35L capacity aquaria filled with 25L of dechlorinated tap water for 14

days. Fish were fed to satiation at 0800 and 1600hr with a commercial fish feed (Vital feed®). Three quarters of water in the tanks were siphoned out daily to remove uneaten feed and faecal matter and replaced with clean dechlorinated tap water.

2.2 Methods

2.2.1 Preparation of Acute Concentrations of Crude Leaves Extract (CLE) of *L. inermis*

Series of range finding test (RFT) were conducted according to the methods described by [24] and from the results of the RFT, definitive concentrations of (0.60, 0.50, 0.40, 0.30 and 0.2g/L) were obtained for the acute bioassay. Test concentrations were prepared by weighing 6.0t, 5.00, 4.00, 3.00 and 2.00g of the powdered leaves of *L. inermis* and each concentration was macerated for 24 hours in 10L of distilled water. Each macerated concentration was filtered through funnel choked with non-absorbent cotton wool into five (5) rectangular plastic tanks (60x40x40cm) arranged in randomized block design each duplicate replicated, A control tank (0.00g/L) did not contain the test material and was also replicated,

2.2.2 Procedure for Conducting Acute Bioassay

Static non-renewable bioassay was used for the acute toxicity test. The test was conducted on 120 on. of *T. zillii* fingerlings in twelve (12) 20L capacity rectangular plastic tanks (test and control tanks each duplicate replicated) each containing 10 fish per tank. The treatment tanks were inoculated randomly with graded concentrations (0.20, 0.30, 0.40, 0.50, and 0.60g/L) of CLE of *L. inermis* plant material. *T. zillii* fingerlings which were starved 24 hours prior to the commencement of the experiment. Following starvation, fish were then exposed to the CLE of *L. inermis* via immersion technique to graded concentrations of 0.20, 0.300, 0.40, 0.50, and 0.60g/L of the plant material for 96 hours (4 days) using standard procedures [24]. Throughout the bioassay, test fish were not fed and natural photo period (12Light:12dark) was maintained. Mortalities encountered were removed, counted and converted to probit values for the determination of 96 hr. LC₅₀ of the test substance [25].

2.2.3 Collection of Blood and Haematological Analysis

Blood (1ml) was collected from *T. zillii* fingerlings exposed to the acute concentrations of CLE of *L. inermis* through cardiac puncture [22] using 1ml syringe and blood transferred into specimen bottles treated with Ethylene Diamine Tetra Acetic Acid (EDTA). Blood indices of packed cell volume (PCV), white blood corpuscle (WBC),

red blood corpuscle (RBC), and haemoglobin (Hb). Others are neutrophils (Neu), lymphocytes (Lym) were analyzed based on the Standard Operational Procedure (SOP) of [26]. Other blood parameters such as mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were computed according to the following formulae as described by [27].

$$MCV = \frac{Hb \left(\frac{g}{dl} \right) \times 10}{RBC (X10^{12})}$$

$$MCHC = \frac{Hb \left(\frac{g}{dl} \right) \times 1000}{Haematocrit (\%)}$$

$$MCV = \frac{Haematocrit (\%) \times 10}{RBC (X100)}$$

2.2.4 Collection of Blood and Biochemical Analysis

Exactly 1ml of blood was collected from surviving fish using 1ml syringe into non-heparinized tubes, EDTA through cardiac puncture and centrifuged at 1500rpm for 5min to obtain plasma [23]. The activities of Alkaline phosphatase (ALP), Aspartate aminotransferase (AST), Alanine aminotransferase (ALT), Total protein (TP), Albumin (ALB), High density lipoproteins (HDL), Low density lipoproteins (LDL) and Lactate dehydrogenase (LDH) were assayed using GENESYS-20 spectrophotometer (GENESYS 20. Thermo Electron Corporation USA) following the manufacturer's instruction of the enzymes of Randox, Spectrum and Fortress reagent kits.

2.3.5 Statistical Analyses

Data were analyzed by one-way Analysis of Variance (ANOVA) using SPSS (version 16.0) software. Treatment means were separated using Tukey's multiple comparisons test, pos. Level of significance was determined at P=0.05 level of probability and a PO.05 value was considered statistically significant.

3.0 Results and Discussion

Mean mortality of *T. zillii* fingerlings exposed to concentrations of *L. inermis* is presented in Table 1. Percentage mortality of the experimental fish decreased with decrease in concentration of toxicant. There was 100% mortality at concentration 0.60g/L while 80% mortality was recorded at 0.50g/L of the test substance. Concentration 0.40, 0.30, and 0.2g/L recorded 50, 20 and 10% mortalities respectively. No mortality was recorded in the control (0.00g/L).

Table 1 Mean Mortality Rate, Percentage and Probit Mortality of *T. zillii* Fingerlings exposed to Acute Concentrations (96 hr. LC₅₀) Aqueous CLE of *L. inermis*.

Conc. (g/L)	Log Conc.	Mortality (Hours)									Total Mortality	Mortality (%)	Probit Mortality
		2	4	8	16	24	36	48	72	96			
0.60	-0.22	0.0	2.5	2.5	3.5	1.5	0.0	0.0	0.0	0.0	10.0	100	8.72
0.50	-0.30	0.0	0.0	2.0	2.0	2.0	1.0	0.0	1.0	0.0	8.0	80	5.84
0.40	-0.14	0.0	0.0	0.0	0.0	0.0	1.0	3.0	1.0	0.0	5.0	50	5.00
0.30	-0.52	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.5	0.0	2.0	20	4.16
0.20	-0.70	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.5	1.0	10	3.18
0.00	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00

Linear relationship between mean probit mortality and log concentration of *T. zilli* fingerlings exposed to aqueous crude leaves extract of *L. inermis* is presented in Figure 1. The calculated 96hr LC₅₀ value of aqueous crude leaves extract of *L. inermis* on *L. zilli* fingerlings is 0.38g/L with upper and lower confidence limits of 0.45 and 0.32g/L respectively.

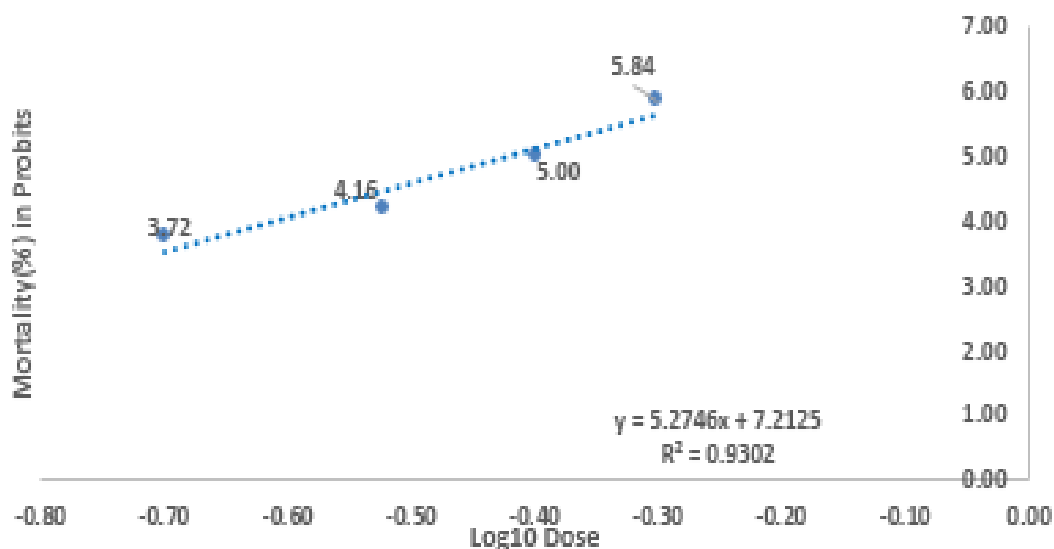


Fig. 1 Linear Relationship between Probit Mortality and Log Concentrations of *T. zillii* Fingerlings exposed to Acute Concentrations (96 hr. LC₅₀) of Aqueous CLE of *L. inermis*.

Results of acute concentrations of aqueous crude leaves extracts of *L. inermis* on blood indices of *T. zillii* fingerlings are represented in Table 2. Significant ($P < 0.05$) alterations on the WBC with no significant ($P < 0.05$) effects on PVC, RBC, Hb, MCV, MCHC < N and L. extracts concentration 0.60g/L recorded the highest mean WBC value ($7.55 \pm 2.50 \times 10^9$ mg/L) while the lowest value ($3.80 \pm 0.20 \times 10^9$ mg/L) was recorded in 0.30g/L. PCV recorded highest mean percentage ($2.9.00 \pm 2.00\%$) in concentration 0.50g/L while concentration 0.30g/L recorded the lowest ($12.5 \pm 0.25\%$). Similarly, Hb and Neu recorded highest mean values of 9.65 ± 0.65 mg/L and $38.00 \pm 11.00\%$

Table 2: Mean Blood Indices of *T. zillii* exposed to Acute Concentrations (96hr. LC₅₀) of Aqueous CLE of *L. inermis*

respectively in concentration 0.50g/L and lowest values of 4.15 ± 0.85 mg/L and $27.00 \pm 2.50\%$ respectively in the highest concentration 0.60g/L of the leaves extract. With MCV, the highest mean value (60.00 ± 0.00 fl) was recorded in concentration 0.40g/L while the lowest value (35.30 ± 3.90 fl) was recorded in highest concentration (0.60g/L). the highest mean values of MCH (20.00 ± 0.00 pg) was recorded in the concentration 0.40g/L while the lowest (12.24 ± 3.75 pg) was recorded in the control. The control recorded the highest mean MCHC (33.30 ± 3.75 g/dl) while concentration 0.30g/L had the lowest value (33.10 ± 0.10 g/dl).

Blood Parameters	Concentrations (g/L)						P value
	0.00	0.20	0.30	0.40	0.50	0.60	
PCV (%)	28.00±16.0	17.00±7.00	15.50±4.50	22.50*2.00	29.00*2.00	12.50*2.50	0.575
WBC (x10 ⁹ mg/L)	5.35*0.75	8.35±0.35*	3.80±0.20*	7.25±0.35*	4.55±4.55*	7.55±0.15*	0.33
RBC (x10 ⁹ mg/L)	6.85C2.25	3.50±0.30	3.35±0.15	7.25±0.35	5.10±0.20	3.35±0.25	0.190
MCV (fl)	37.25±11.15	47.25± 15.95	49.10±12.00	60.00±0.00	56.80±1.70	37.00±3.90	0.486
MCH (pg)	12.24±3.75	15.20±4.90	17.55±5.25	20.00±0.00	18.90±1.70	12.25±1.66	0.514
MCHC (g/dl)	33.30±3.75	33.15±0.15	33.10±0.10	33.30±0.00	33.25±0.05	33.15±0.45	0.505
Hb (mg/L)	9.35±5.30	5.65±2.35	5.80±1.50	8.50±0.50	9.65±0.65	4.15±0.85	0.574
Neil (%)	27.00±2.30	33.00±4.00	27.50±1.50	28.00±9.00	38.00±11.00	27.00±2.50	0.766
Lym (%)	73.00±2.00	70.50±8.50	72.50±2.50	71.50±9.50	66.50±16.50	72.50±2.69	0.999

Values with Asterisks (*) in the same row are significantly different {P<0.05} compared with the control

PCV= Packed Cell Volume; RBC= Red Blood Corpuscles; MCV=Mean Corpuscular Volume; WBC= White Blood Corpuscles; MCH=Mean

Corpuscular Haemoglobin; Neu=Neutrophil; MCHC=Mean Corpuscular Haemoglobin Concentration; Hb=Haemoglobin concentration; Lym =

Lymphocyte

The present study revealed that aqueous CLE of *L. inermis* affects the biochemical parameters of *T. zillii* fingerlings as indicated in Figures 2, 3 and 4. From the results, concentrations of AST, ALT and ALP increased with increase in concentration of crude leaves extract of *L. inermis* (Figure 2). Mean AST was highest (162.96U/L) in the highest concentration (0.60g/L and lowest in the lowest

concentration 0.20g/L) of the leaf extract. Highest mean ALT (42.28U/L) was recorded in concentration 0.50g/L of the leaves extract while the lowest value (2.10U/L) was recorded in the control. Similarly, mean ALP was highest (71.80U/L) in extract concentration 0.50g/L and lowest (11.08U/L) in the control. Significant (PO.05) differences exist between the activities ALP, AST and ALT compared with the control.

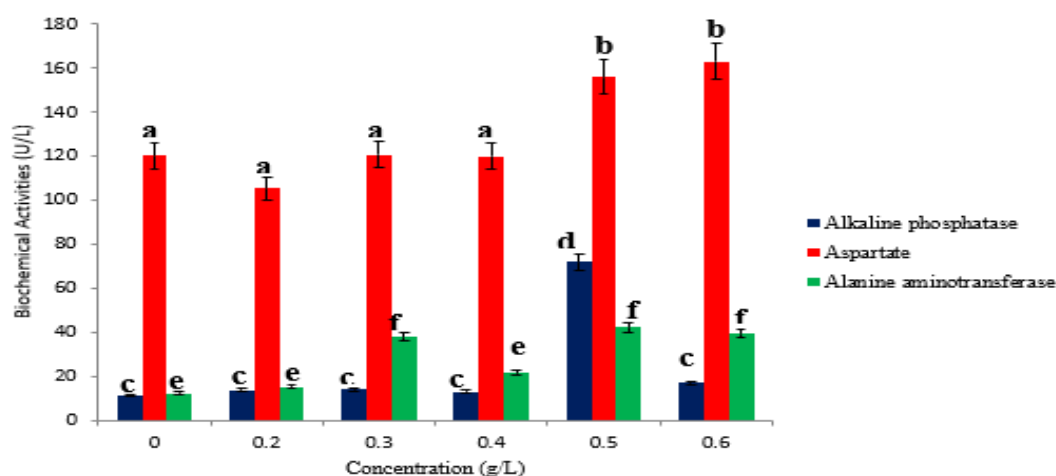


Figure 2: Plasma Alkaline phosphatase, Aspartate aminotransferase and Alanine aminotransferase Activities in *T. zillii* Treated with Aqueous Extract of *L. inermis* Leaf

Bars with dissimilar alphabets among different concentrations are significantly different at $p < 0.05$.

Mean TP and ALB are presented in Figure 3. ALB increased in concentration of crude extracts of *L. inermis* but TP maintained an irregular pattern as concentration of the leave extracts increased. Peak mean ALB (33.65g/dl) was in the highest concentration (0.06g/L) of the extract and lowest

(10.92g/dl) in concentration 0.30g/L. in the contrary, the lowest concentration of the CLE (0.20g/L) recorded the highest mean TP (63.76g/dl) while the control recorded the lowest value (23.79g/dl). Significant ($P < 0.05$) differences exist between the activities of TP compared with the control however, there is no significant difference ($P > 0.05$) in ALB in test fish compared with the control.

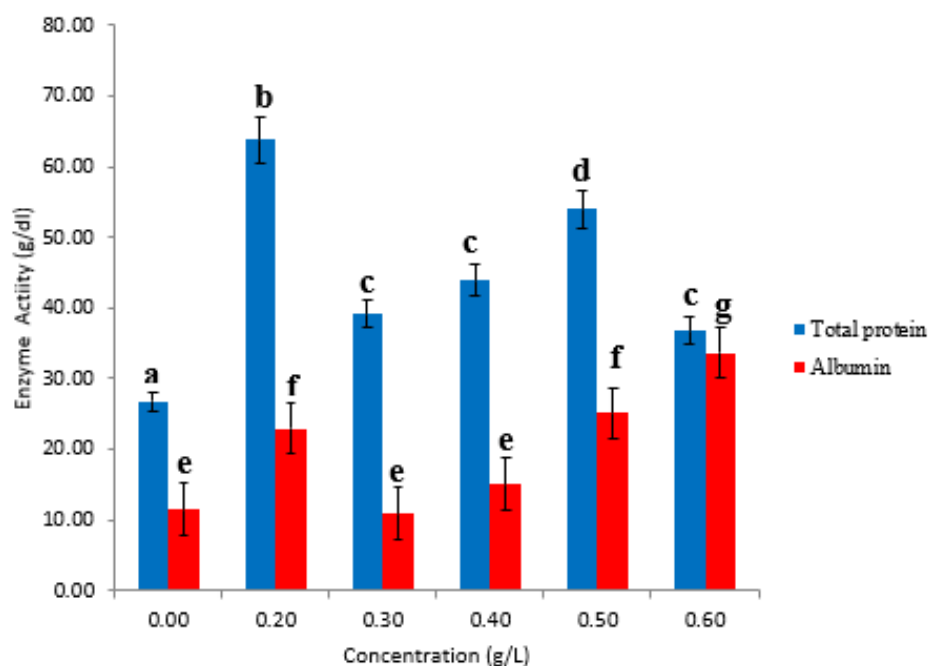


Fig. 3 Mean Total protein and Albumin of *T. zillii* Fingerlings exposed to Acute Concentrations of CLE of *L. inermis*

Bars with dissimilar alphabets among different concentrations are significantly different at $p < 0.05$.

The biochemical activities of LDH, Cholesterol, HDL and LDL were presented in Figure 4. These biochemical parameters also increase with increase in concentrations of crude extract of *L. inermis*. Mean LDH progressively increases from 2.48mg/L in the control to 4.64mg/L in the

highest leave extracts concentration (0.60 g/L). Cholesterol was highest (13.30 mg/L) IN concentration 0.50g/L and lowest (2.65mg/L) in the control. Similarly, LDL recorded the highest mean value (10.37 mg/L) in concentration 0.50g/L and lowest (1.76mg/L) in concentration 0.20g/L. there is significant ($P < 0.05$) difference between the activities of LDH in all the test concentrations compared to the control (0.00g/L)

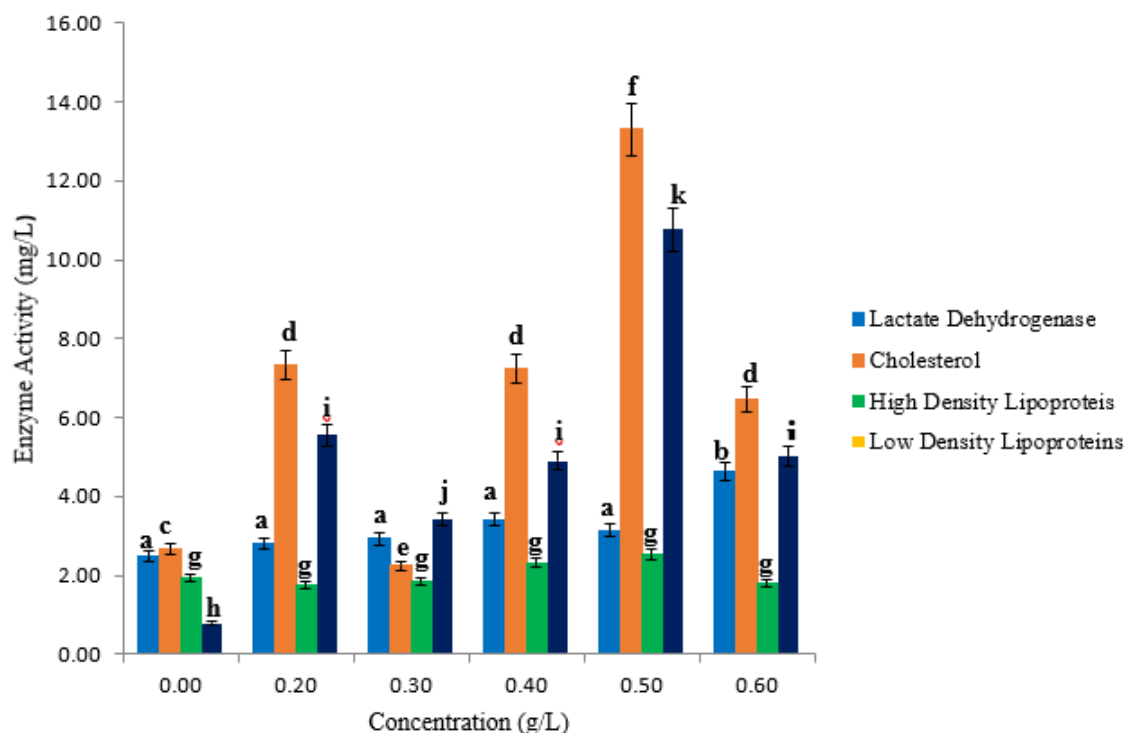


Figure 4: Changes in the Serum Lipid Profile in *T. zillii* Treated with Acute Concentrations *L. inermis*

Bars with dissimilar alphabets among different concentrations are significantly different at $p < 0.05$.

The results of the acute toxicity experiment showed that the aqueous CLE of *L. inermis* caused significant ($P < 0.05$) changes in the survival rate of *T. zillii* fingerlings. There was increase in mortality rates of the fingerlings as the concentration of the toxicant increased. This is similar to the findings of [6] who reported increase in mortality of *Mugil cephalus* with increase in concentration of leave extract of *L. inermis*. The present study also corroborates the finding of [28], that mortality of *O. niloticus* fingerlings increased with increase in concentration of *M. oleifera*. The dose-dependent relationship as present findings are also in line with the report of [19] that mortality of *O. niloticus* fingerlings increase with increase in acute concentrations of aqueous crude leaves extracts of *Balanites aegyptiaca* after 96 hours acute exposure.

The 96hr LC_{50} value of crude leaves extract of *L. inermis* on *T. zillii* was 0.38g/L with upper and lower confidence limits of 0.45 and 0.32g/L. The 96hr LC_{50} (0.38g/L) reported in the present study is lower than that of *Azadirachta indica* extract (0.56g/L) on freshwater catfish (*Pangasius hypophthalmus*) reported by [29] and the 2.42g/L of aqueous seed powder of *M. oleifera* on *C. gariepinus* fingerlings reported by [30]. Different authors have reported lower 96hr LC_{50} values of plant extracts on different fish species. For instance, [16] reported 0.129mg/L of *C. papaya* on *C.*

gariepinus fingerlings; [2] reported a value of 0.35mg/L of aqueous extract of *Psychotria microphylla* leaves on *C. gariepinus* juveniles. Furthermore, [19] reported a much lower value of 0.26g/L of aqueous CLE of *B. aegyptiaca* on *O. niloticus* fingerlings. In contrast, [31] documented higher 96 hr LC_{50} values of 18.99, 20.72 and 20.72 mg/L three adult fish species: *Brycinus nurse*, *Labeo barbus bynni* and *Labeo barbus intermedius* were exposed to stem bark extracts of *B. aegyptiaca* extract respectively. The variation in the 96hr LC_{50} values in literature could be attributed to the differences in species, size and age of fishes, as well as the plants by their composition.

The present study also showed that *L. inermis* leaves extract does not significantly affect

RBC, PCV, Hb, MCV, MCH, MCHC, N and L but have significant effect on WBC of *T. zillii*

fingerlings. This result is not in conformity with the findings of [14] who reported that leaves of *L. inermis* had no effects on haematological parameters of Albino Wistar Rats. Similar result was reported by [32] after exposing *C. gariepinus* to aqueous extracts of desert date (*B. aegyptiaca*).

The present results are in contrast with the findings of [33] that PCV, Hb and RBC significant decreased in *O. niloticus* exposed to concentrations of cadmium chloride. The increase in WBC counts with increase in the

concentration of *L. inermis* in this study is similar to the findings [34] who reported increase in values of WBC in *C. gariepinus* exposed to *Tephrosia vogelii* leaves extract. The increase in WBC could be due to attempt by the fish to fight against the pollutants [13].

Enzymes assays such as AST, ALT ALP, and LDH have been used as indicators of different stress conditions in fishes [33; 35]. Biochemical change in fish is aimed at maintaining equilibrium in the presence of toxicant that may affect physiological and biochemical processes [35]. The present study showed that crude leaves extract of *L. inermis* caused changes in ALP, AST, ALT, TP, LDH, HDL, LDL and Cholesterol of *T. zillii*. This is in line with the findings of [33] that AST and ALT enzymes activities increase in *O. niloticus* exposed to cadmium chloride. The increased activities of AST and ALT are indications of tissue damage in fish [36]. In the present study blood indices and biochemical parameters were altered.

4. Conclusions

The physiological changes shown in the haematological and biochemical parameters of *T. zillii* fingerlings exposed to crude leaves extract of *L. inermis* is detrimental to the general health of the fish. The established LC₅₀ value may help in establishing the safer limits of the crude leaves extract of *L. inermis* in aquatic environment and aquaculture systems. Artisanals should be wary of the using of leaves of *L. inermis* in ponds owing to it lethal effects on fish. The use of *L. inermis* leaves to harvest fish and channelling of domestic effluent containing *L. inermis* into aquatic environment should be discouraged.

Acknowledgment

The authors wish to thank the staff of haematology and biochemistry units of National Veterinary Research Institute, Vom, Plateau State, Nigeria.

References

[1] Anju, T. D., Solomon, S. G., and Cheikyula, J. O. 2015. "Effects of Aqueous Crude Leaves Extract of *Tephrosia vogelii* as a Tranquilizer on the African Catfish, *Hetreobranchius longifilis* Val. (Pisces 1840)." *American Journal of Research Communication* 3: 45-59.

[2] Orji, O. U., Ibiam, U. A. and Aja, P. M. 2014. "Acute toxicity studies of the Lyophilized Aqueous Extract of *Psychotria microphylla* leaves on *Clarias gariepinus* Juveniles." *International Journal of Biological Science* 3: 03 8-044.

[3] Sogbesan, O. A., and Emmanuel, Y. N. 2015. "Survey and Availability of Some Piscicidal Plants Used by Fishermen in Adamawa State, Nigeria". *Journal of*

Environmental Science, Toxicology and Food Technology, 9, 28-31.

[4] Mohotti, C. R. W. C. and Epa, U. P. K. 2016. "Toxicity of Aqueous Extract of White hoary pea, *Tephrosia Candida* (Papilionoideae) on Nile tilapia, *Oreochromis niloticus* (Cichlidae) Fingerlings ". *Sri Lanka Journal of Aquatic Science* 21:105-112.

[5] Oufayyo, M. O. (2009). "Haematological Characteristics of *Clarias gariepinus* (burchell 1822) Juveniles Exposed to *Derris elliptica* Root Powder". *African journal of food Nutrition and development*, 9: 920-934.

[6] Manikandan, A., Revathi, R., Merrine, R., Geethanjali, S. and Poorni. K. 2011. "Acute Toxicity Study of Hydroethanolic Leaves Extracts of *Lawsonia inermis* and *Mangifera indica* on *Mugil Cephalus*". *International Journal of Pharmaceutical Technology* 30: 1768-1776.

[7] Oyen L P. A. 1991. "*Lawsonia inermis* L. Record from Proseabase. In: R. H. M. J. Lemmens, and Wulijarni-Soetjpto, N. (Eds.). Bogor, Indonesia; PROSEA (*Plant Resources of South- East Asia*) Foundation". Retrieved from <http://www.proseanet.org> on August 15th, 2017.

[8] Borade, A. M., Kale, B. N. and Shete, R. V. 2011. "A phytopharmacological Review on *Lawsonia inermis* (Linn) ". *International Journal of Pharmaceutical Life Sciences* 2: 536-541.

[9] Khem, C., Jangid, B. L. and Rao, S .S. 2003. "Henna: A potential Source of Non-farm Employment and Economic Development in Arid Fringes ". *Agriculture Economic Research Review. Conference issue*. 179.

[10] Amit, S. B., Babasaheb, N. K. and Rajkumar, V. S. 2011. "A Phytopharmacological Review on *Lawsonia inermis* (Linn.) ". *International Journal of Pharmaceutical and Life Science* 2:536-541.

[11] Nayak, S., Chakraborti, C. K., Jaiswal, P., Sah., U. K. and Mohanta, D. S. D. 2012. "Correlation between Phytochemical Constituents and Anthelmintic Activity of *Lawsonia innermis* Leaf Extract". *International Journal Research*.3:559-562.

[12] Audu, B.S., Yusuf, S., Malachy, N.O.A., Jamiu, O. and Wade, J.W 2018. "Phytochemical, Proximate and Sedative Properties of Henna (*Lawsonia innermis*) on the Opercula Ventilation Rate of *Tilapia zillii* Fingerlings ". *Science World Journal* 13:16-20.

[13] Mudi, S. Y., Ibrahim, H. and Bala, M, S. (2011). "Acute Toxicity Studies of the Aqueous Root Extract of

Lawsonia inermis Linn. In Rats ". *Journal of Medicinal Plants Research*, 5,20.

[14] Manpreet, K., Dangi, C. B. S., Ashish, S., Madulika, S., Sasmit, K., Hardev, Singh, J. P. and Shikha. J. 2014. "Toxicity Profile of Ethanolic Extract of *Lawsonia innermis* Leaves in Albino Wisters Rats", *World Journal of Pharmacy and Pharmaceutical Sciences* 3:835-848.

[15] Castano, A., Cantarino, M. J, Castillo, P. and Tarazona, J. V, (1996). "Correlation between the RTG-2 Cytotoxicity Test EC₅₀ and in Vivo LC₅₀ Rainbow Trout Bioassay". *Chemosphere* 32: 2141-2157.

[16] Ezekiel, O. A., Benedict, O. O., Iron, B. O., Gabriel, U. I., Stephen, N. O., Nnanke, E. A. and Dodeye, E. O. 2010. "Toxicity of Pawpaw (*Carica papaya*) Seed Powder to Sharptooth Catfish, *Clarias gariepinus* fingerlings and Effects on Haematological Parameters", *International Journal of Fish Aquaculture* 2: 71-78.

[17] Okey, I. B., Gabriel, U. U. and Deekae, S. N. 2018. "Comparative Effects of the Acute Toxicity of Clove (*Eugenia Aromaticd*) Powder to *Clarias Gariepinus* and *Heterobranchus Bidorsalis* Fingerlings", *International Journal of Innovative Studies in Aquatic Biology and Fisheries* 4:32- 39.

[18] Suely, A., Zabed, H., Ahmed, A. B. A., Mohamad, J., Nasiruddin, M., Sahu, J. N. and Ganesan, P. 2015. "Toxicological and Haematological Effect of *Terminalia arjuna* Bark Extract on a Freshwater Catfish, *Heteropneustes fossilis*". *Fish Physiology and Biochemistry* A, 1:1-15.

[19] Audu, B. S., Wakawa, A. I., Yusuf, S. and Likita. P. M. 2019. "Acute Toxicity of Aqueous Crude Leaves Extract of Desert Date (*Balanites aegyptiaca*) on Blood Cells and Serum Biochemistry of Nile Tilapia (*Oreochromis niloticus*) Fingerlings". *International Journal of Fish and Aquaic Studies* 7: 356-364.

[20] Olaniyi, C. O., Adewoye, S.O., Ismail, M.O and Adeseun, F. M. (2013). "Effect of Cassava Mill Effluents on Haematological and Biochemical Characteristics of Adult African Catfish (*Clarias Gariepinus*)". *Journal of Biology, Agriculture and Healthcare*, 3; .

[21] Olusegun, A. A. and Adedayo, O. O. 2014. "Haematological Responses, Serum Biochemistry and Histology of *Clarias gariepinus* (Burchell, 1822) Exposed to Sub-lethal Concentrations of Cold Water Fresh Root Bark Extracts of *Plumbago zeylanica* (Leadwort)" *Jotvrrta/ of Aquatic Research Development* 5:1-6.

[22] Audu, B., Adamu, K. M. and Nonyelu, O.N (2014). "Changes In Haematological Parameters Of *Clarias Gariepinus* Exposed To Century Plant (Agave Americana) Leaf Dust¹". *International Journal of Applied Biological Research* 6: 54 - 65.

[23] Audu, B. S., Kabir, M. A. & Ofojekwu, P. C. 2014. "Biochemical Parameters of Common Carp (*Cyprinus carpio*) Exposed to Aqueous crude leaves extract of *Cannabis sativa*". *Jordan Journal of Biological Sciences* 7; 147-151.

[24] Organization for Economic Cooperation and Development, 1992. "Guideline for the Testing of Chemical" *Fish, Acute Toxicity test* 203: 6-10.

[25] Rezende, F. P., Pascoal, L. M., Vianna, R. A., and Lanna, E. A. T. 2017. "Sedation of Nile Tilapia with Essential Oils: Tea tree, Clove, *Eucalyptus*, and Mint oils". *Revista Caatinga*, 30: 479- 486.

[26] Blaxhall, P. C. and Daisley, K. W. 1973. " Routine Haematological Methods for Use with Fish Blood ". *Journal of Fish Biology* 5: 771-781.

[27] Wintrobe, M. M. 1967. *Clinical Hematology*, 6th ed. Lea and Febiger, Philadelphia, USA. [28] Ayotunde, E.G., Offem, B.O. and Bekeh, A.F. 2011. "Toxicity of *Carica papaya* Linn: Haematological and Piscidal Effect on Adult Catfish (*Glorias gariepinus*) ". *Journal of Fish and Aquatic Science*, 6: 291-308.

[29] Suresh, B. C., Shailender, M. R. and Krishna, P .V. 2013. "Effect of Acute Toxicity of *Azadirachta indica* on the Survival of Freshwater Cat Fish, *Pangasius hypophthalmus*". *International Journal Research of Biological Science* 3:112-115.

[30] Ayotunde, E.G., Offem, B.O. and Bekeh, A.F. 2011. "Toxicity of *Carica papaya* Linn: Haematological and Piscidal Effect on Adult Catfish (*Clarias gariepinus*)". *Journal of Fish Aquatic Science* 6: 291-308.

[31] Alamrew, E. and Abebe, G. 2019. "Acute Toxicity Evaluation of Water Extract Stem Barks of *Bafanites aegyptiaca* on Adults of Three Different Fish Species". *Journal of Toxicology Environmental Health Science* 11:9-15.

[32] Absalom, K. V., Nwadiaro, P. O., and Wophill, N. 2013. "Toxicity of aqueous extract of desert dale (*B. aegyptiaca* Linnaeus) on the juveniles of catfish (*Clarias gariepinus* Teugels, 1986)". *Journal Agriculture and Veterinary Sciences* 3: 13-18.

[33] Nasser, A. A., Abdel-Wahab, A. A., El-Sayad, M. Y. and Hassan, H. Y. A. 2015. " Hacmatoiological and Biochemical Parameters and Tissue Accumulations of

Cadmium in *Oreochromis niloticus* exposed to Various Concentrations of Cadmium Chloride ". *Saudi Journal of Biological Science* 22: 543-550.

[34] Adewoye, S. O. 2010. "Haematological and Biochemical Changes in *Clarias gariepinus* exposed to *Torpesia vogelii* Extract". *Advanced Applied Science Research* 1; 74-79.

[35] Akinrotimi, O. A., Edun, O. M. and Ukwe, O. I. K. 2018. "Effects of Anaesthetics on Metabolic Enzyme

Activities in African Catfish, *Clarias gariepinus* (Burchell, 1822) ". *Journal of Fish, Science*, 12: 22-28.

[36] Giron-Pirez, M. I., Santerre, A., Gonzalez-Jaime, F., CasasSolis, J., Hernandez-Coronado, M. and Peregrina-Sandoval. 2007. "Immunotoxicity and Hepatic Function Evaluation in Nile Tilapia (*Oreochromis niloticus*) exposed to Diazinon". *Fish Shellfish Immunotoxicity* 23:760-769.