

HISTOPATHOLOGICAL ALTERATIONS IN SOME ORGANS OF *Clarias gariepinus* JUVENILES EXPOSED TO SUBLETHAL CONCENTRATIONS OF *Albizia gummifera* CRUDE BACK EXTRACTS

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Abstract: The traditional fishing with *Albizia gummifera* could not be environmentally friendly to the aquatic ecosystem. This study investigated the sub-lethal effects of crude back extracts of *A. gummifera* on histology of gills, liver, kidney and gonads of *Clarias gariepinus* juveniles. Fish juveniles were exposed to sub-lethal concentrations (1.00, 2.00 and 3.00 g/L) obtained by using 1/10th, 1/15th and 1/20th of 2.5g/L LC₅₀ value of *A. gummifera* for 56 days with untreated control (0.00g/L). The routine Paraffin wax method and hematoxylin eosin staining techniques of tissue processing were adopted for the examination of the organ histology of the exposed fish. The organ histomorphology in *C. gariepinus* juveniles from the control 0.00g/L tanks showed normal morphology. Histopathological lesions increase with an increase in the concentration of the plant extract. Alterations in gills are slight atrophy in midline cartilage and primary lamellae as well as complete loss of secondary lamellae. The liver exhibited atrophy, inflammation, and slightly thickened cellular demarcations and the nuclei are severely shrunk. The kidney indicated atrophy as evidenced by the increase in interstitial spaces and necrosis as seen by the loss of cellular materials. Testes showed severe atrophy, massive tissue degeneration, and massive loss of spermatozoa and the seminiferous tubules appear empty. Ovarian damages are atrophy and shrunk perfollicular cells, the previtellogenic oocyte and vitelline envelope are greatly reduced in size and there is loss of vitellogenic oocyte. In conclusion, sublethal concentrations of crude back extract of *A. gummifera* induced histological alterations in some vital organs and reproductive organs of *C. gariepinus* juveniles therefore it should be used with caution during fishing.

Keywords: Peacock flower, Catfish, Sub-Lethal, Histopathology Alterations.

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Introduction

The indiscriminate discharge of piscicidal plants has harmful consequences for aquatic organisms and biota, including fish (Sogbesan and Emmanuel, 2015). *Albizia gummifera* from the family Fabaceae (commonly known as peacock flower) is a fast-growing tree that is widely distributed in Africa, sub-tropical and tropical (Singab *et al.*, 2015). *Albizia* species are used in folk medicine for the treatment of rheumatism, stomachache, cough, diarrhoea, wounds and as anthelmintics (Karuppannan *et al.*, 2013). *Albizia* extracts are known for their rapid and effective action in reducing fish populations, particularly in cases of overpopulation or invasive species (Tayyab *et al.*, 2018; Kaur *et al.*, 2020). *Albizia* extracts are toxic to bacteria, parasites and mosquitoes and display ichthyotoxic properties (Hanitra., 2104). The piscicidal activity of *Albizia* species extracts is attributed to the presence of bioactive compounds such as saponins, alkaloids, and flavonoids which disrupt fish physiology by affecting

respiratory function, ion regulation, and nervous system activity (Kamble *et al.*, 2019; Yadav *et al.*, 2021).

African catfish exhibit unique biological characteristics, including air-breathing capabilities, nocturnal feeding behaviour, and rapid growth rates. They are omnivorous opportunistic feeders, consuming a wide range of prey items including insects, crustaceans, and small fish (Bruton *et al.*, 2007; Kumar *et al.*, 2018).

Fish histology is vital in assessing the impacts of pollutants on aquatic Animals. Examining tissues such as the skin, gills, liver, kidney, muscles, brain, intestine, testis and ovaries provides insights into the pathological effects of substances which can have significant implications for the health, reproduction and survival of the exposed Animals. According to Salamat and Zarie (2012), the liver is a detoxification organ and it is essential for both, the metabolism and the excretion of toxic substances in the fish body. Gills are vital respiratory and osmoregulatory organs in fish, highly

sensitive to aquatic pollutants due to their direct contact with the environment while the kidney plays an important role in excretion and osmoregulation, and its histology can be significantly affected by toxicant exposure. Hepatocellular degeneration, central and sinusoidal congestions in the liver of *C. gariepinus* juveniles exposed to acute concentrations of crude leaf extracts of *Vernonia amygdalina* for four days was reported by (Audu *et al.*, 2017). Histological alterations such as hyperplasia, desquamation, necrosis of epithelial, epithelial lifting, oedema, lamellar fusion, collapsed secondary lamellae, curling of secondary lamellae and aneurism in the secondary lamellae were observed in the gill of *Cirrhinus mrigala* exposed to 10 days sub-lethal concentrations of dichlorvos (Velmurugan *et al.*, 2009). Liver and kidney showed atrophy, haemorrhage, necrosis, hypertrophy and hyperplasia while gills indicated lamellae fusion, secondary lamellae erosion, desquamation, atrophy and haemorrhage in *O. niloticus* fingerlings exposed to the concentrations of aqueous crude leaf extract of *B. aegyptiaca* for 96 hours (Wakawa and Audu, 2022). Alterations in the kidney of *C. gariepinus* exposed to a sub-lethal dose of *Melaleuca cajuputi* leaves extract were vacuolation, hydropic degeneration, pyknosis, and tubular necrosis (Marina *et al.*, 2023).

Reproductive organs are sensitive indicators of the toxic effects of xenobiotics as they are critical for species propagation. Exposure to different plant toxicants leads to histological changes in *C. gariepinus* such as necrotic conditions in spermatogenic cells, nuclear pyknosis and cytoplasmic swelling, while vacuolations, flabby oocytes, and signs of ovarian degeneration after exposure to lambda-cyhalothrin (Samuel *et al.*, 2021). Severe sloughing off of seminiferous tubular boundary tissue and a significant depletion of seminiferous luminal content was reported in catfish exposed to sublethal concentrations of *Vernonia amygdalina*. (Sulaiman *et al.*, 2022).

However, there is a lack of information regarding the impact of sub-lethal concentrations of *A. gummifera* crude bark extract on the histology of liver, gills, kidney, ovaries and testes of juvenile *Clarias gariepinus*. Therefore, this research aims to address this knowledge gap and provide insights into the potential effects of *A. gummifera* on the histological integrity of some organs of *C. gariepinus* juveniles.

Materials and Methods

Description of Study Area

The study was carried out at the Laboratory Unit of the Department of Zoology, Natural and Applied Sciences, Nasarawa State University, Keffi, Nasarawa State.

Procurement of Experimental plant *A. gummifera*

Albizia gummifera bark was collected from Mangu, Jos, Plateau State, Nigeria and transported to the Laboratory Unit Of Zoology Department, Faculty of Natural and Applied Sciences, Nasarawa State University Keffi.

Preparation of Stock Solution

Albizia gummifera barks were air-dried, pounded and sieved using a 30µm mesh size sieve. A quantity of one (1.00g) of the powdered bark was macerated in one litre (1L) of distilled water for 24 hours (Audu, Adamu and Nonyelu, 2014). The mixture was filtered through a funnel choked with non-absorbent cotton wool and the

filtrate obtained was used as a stock solution (Olaifa, Olaifa and Lewis, 2003).

Collection, Transportation and Acclimatization of Experimental Animal

Clarias gariepinus juveniles of mean length and weight of 13.96±0.38 and 20.66±1.64 were purchased from Rayuwa Fish Farm, Karu Local Government Area, Nasarawa State, Nigeria. Experimental animals were transported in tanks containing water from the pond to the Laboratory unit of the Zoology Department, Nasarawa State University, Keffi. The Fish were transferred into aquaria containing dechlorinated municipal borehole water and allowed to acclimatize to the Laboratory conditions for two weeks. During this period, the fish were fed to satiation at 8:00 am and 6:00 pm with commercial fish feed (Vital feed®).

Sub-lethal Concentrations *A. gummifera* Crude Bark Extract and Test Procedure

The acute toxicity have been performed by Likita (2019), which reported that the 96-hour LC₅₀ value of *A. gummifera* aqueous bark extract is at 2.50g/L on juveniles of African catfish. The sub-lethal toxicity concentrations of 1.00, 2.00 3.00 and 0.0 g/L as the control were obtained by using 1/10th, 1/15th and 1/20th (Abubaka *et al.*, 2018) of the 96-hour LC₅₀ value 2.50g/L in a static renewal bioassay system as described by Organization for Economic Cooperation and Development OECD (2000).

Histological Examination of Gonads of *C. gariepinus* Juveniles Exposed to Sub Lethal Concentrations of Aqueous Bark Extract of *A. gummifera*.

Juveniles of catfish each from treatment and control tanks were removed and dissected to obtain the gills, liver, kidney testes and ovaries. The removed organs were rinsed with distilled water to wash off traces of blood. The organs were preserved in a 10ml specimen bottle containing 5ml of formal saline before transporting to NVRI, Vom. Plateau State, Nigeria, for histological analysis of the tissues.

The routine Paraffin wax method and hematoxylin-eosin staining techniques of tissue processing described by Drury and Wallington (1967) and Avwioro (2011) were adopted for the examination of the organs of *C. gariepinus* juveniles exposed to the toxicants. The harvested organs were fixed in 10% formalin for 3 days, cut into thin slices of 5 x 2 x 1mm thick and then processed with the SPIN Tissue Processor (STP) 120 (Thermo-scientific model). The tissues were buffered in 10% formalin before passing through the following level of hydrocarbon for two hours each: 70%, 80%, 90% and 95% Alcohol; Absolute Alcohol I, II, and III; Xylene I and II; Paraffin Wax Oven I and II.

Tissues were embedded in molten paraffin wax using embedding moulds. The tissues were embedded using embedding cassettes on a tissue Tek Embedding Centre (SLEE MPS/P2) and cooled rapidly on the cooling component. Tissues were sectioned using a rotary microtome (MICROM HM340E Thermo-Scientific) set at 4 micromesh, picked on slides and ready for staining.

Hematoxylin and eosin staining technique was used for the staining of the tissues. Tissue sections were dewaxed and hydrated by passing through two changes of xylene and descending levels of alcohol (100%, 80%, 70%) for three min each and then into water before staining in Harris' hematoxylin solution for 5 min and

washed in running water. They were differentiated in 1% Acid alcohol and then washed thoroughly in water, blued in Scott's tap water substitute for 5 min and rinsed briefly in distilled water. Each tissue was then counterstained in 1% aqueous eosin for 2 min and then washed in water, dehydrated in descending grades of alcohol before clearing in xylene and mounted in Destrene, Plasticiser and Xylene (DPX). Sections were then placed in slide carriers and placed in a 40° C oven to dry overnight. Each tissue was read microscopically. Photographs of the prepared sections were taken using a mounted photo-microscopic camera.

Results

HISTOPATHOLOGY OF ORGANS OF CLARIAS GARIEPINUS JUVENILES EXPOSED TO SUB LETHAL CONCENTRATIONS OF *Albezia gummifera* CRUDE BACK EXTRACTS

The results of gills, liver, kidney, testes and ovaries histology of *C. gariepinus* juveniles exposed to 56 days of SLCs of *Albezia gummifera* crude back extracts

The gills histomorphology in *C. gariepinus* juveniles exposed to aqueous 0.00g/L back extract of *A. gummifera* showing normal morphology, as presented by normal secondary lamellae (black arrows) attached to the primary lamellae (white arrowheads). The midline cartilage (white arrows) is intact, with blood vessels (black arrowheads) within them (Plate 1A). The midline cartilage (white arrows) is slightly atrophied as seen by an increase in interstitial spaces while primary lamellae (white arrowheads) are slightly atrophied in the gills of fish exposed to 0.10g/L of aqueous back extract of *A. gummifera* (Plate 1B). Complete loss of secondary lamellae, making the primary lamellae (white arrowheads) appear as smooth stalks. The midline cartilage (white arrows) is slightly atrophied as seen by an increase in interstitial spaces in fish exposed to 0.20 and 0.30g/L respectively (plate 1C and 1D).

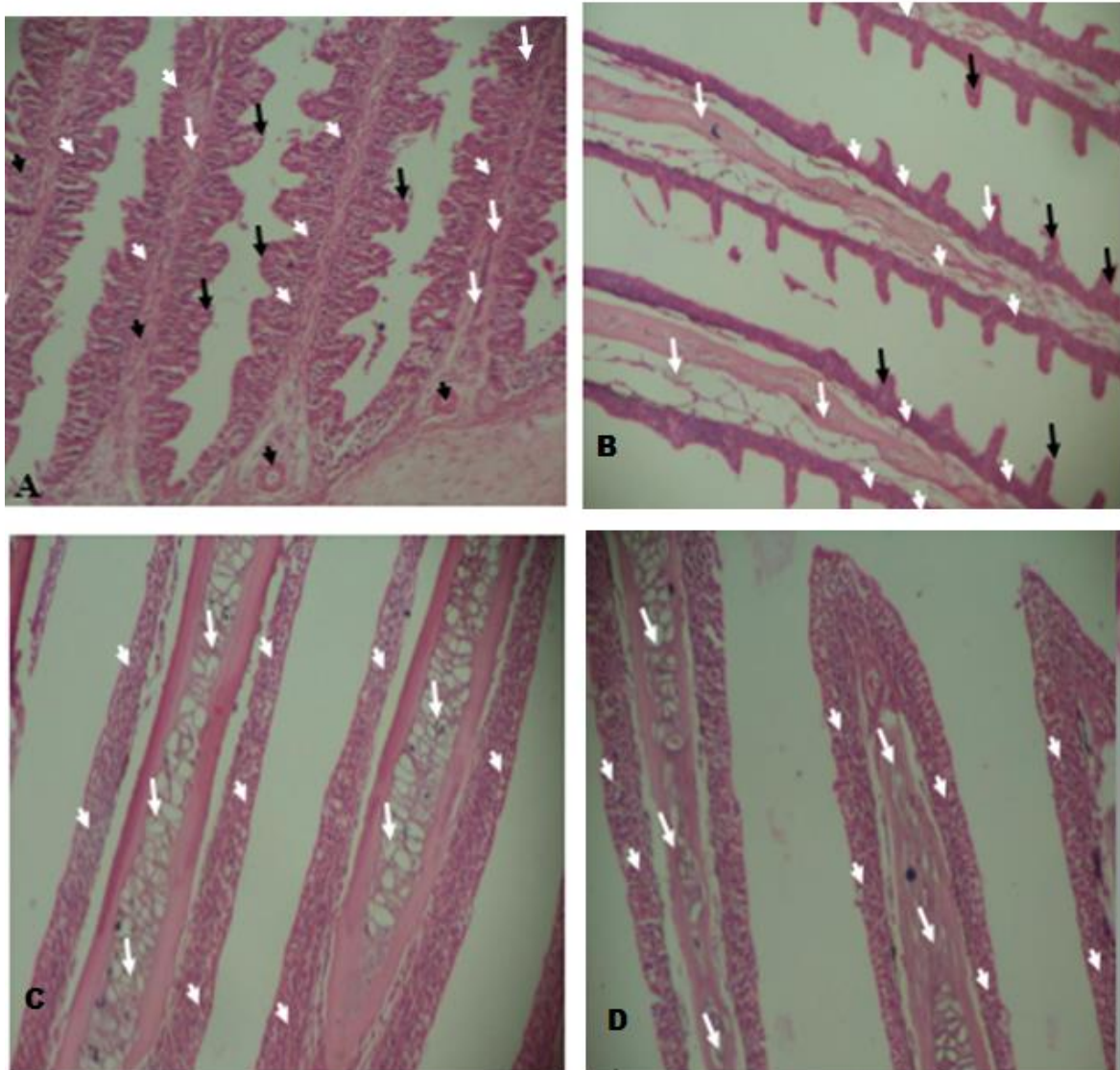


Plate 1: Light micrographs of the Gills of *Clarias gariepinus* Exposed to Sub lethal Concentrations of Aqueous Bark Extract of *Albezia gummifera* HandE A: X100.

A. Control (0.00 mg/L): Showing normal morphology, as presented by normal secondary lamellae (black arrows) attached to the primary lamellae (white arrowheads). The midline cartilage (white arrows) is intact, with blood vessels (black arrowheads) within them. HandE A: X100

B. 0.10 g/L, showing severe atrophy of secondary lamellae (black arrows). The midline cartilage (white arrows) is slightly atrophied as seen by an increase in interstitial spaces. The primary lamellae (white arrowheads) are slightly atrophied.

C. 0.20 g/L, showing complete loss of secondary lamellae, making the primary lamellae (white arrowheads) appear as smooth stalks. The midline cartilage (white arrows) is slightly atrophied as seen by an increase in interstitial spaces.

D. 0.30 g/L, showing complete loss of secondary lamellae, making the primary lamellae (white arrowheads) appear as smooth stalks. The midline cartilage (white arrows) appears normal.

The liver of African Catfish (*Clarias gariepinus*) exposed to 0.00g/L back extract of *A. gummifera*, showed normal morphology as shown by hepatocytes presenting with their characteristic polygonal shape, with nuclei (black arrowhead) surrounded by vacuoles (black arrows) (Plate 2B). The liver of fish exposed to 0.10g/L showed normal morphology (Plate 2B). The cellular demarcations (white arrows) appear intact. Mild atrophy as seen by

the increase in interstitial spaces (black arrows). The cellular demarcations (white arrows). Black arrowheads = cell nuclei are slightly thickened (Plate 2C) in the liver of fish exposed to 0.20g/L. The liver of fish exposed to 0.30g/L, showed inflammation as seen by the presence of inflammatory cells (white arrowheads) within the tissue. There is tissue atrophy as seen by the increase in interstitial spaces (black arrows). The cellular demarcations (white arrows) are slightly thickened. The nuclei (black arrowheads) are severely shrunk (Plate 2D).

The kidney of African Catfish (*Clarias gariepinus*) exposed to 0.00g/L back extract of *Albezia gummifera*., showing normal morphology as shown by the presence of intact glomeruli (white stars), surrounded by a clear zone of capsular space (black arrowheads), glomerular capsule (white arrows) is intact (plate 3A). Kidneys of fish exposed to 0.10g/L, showed normal morphology with mild hypertrophy as seen by the reduction in interstitial spaces (Plate 3B). The kidneys of fish exposed to 0.20g/L, showed atrophy as evident by the increase in interstitial spaces (black arrowheads) and degeneration (necrosis) as seen by the loss of cellular materials (white arrow) (plate 3C). Kidneys of fish exposed to 0.30g/L, showed atrophy as evidenced by the increase in interstitial spaces (black arrowheads) and degeneration (necrosis) as seen by the loss of cellular materials white arrows) (3D).

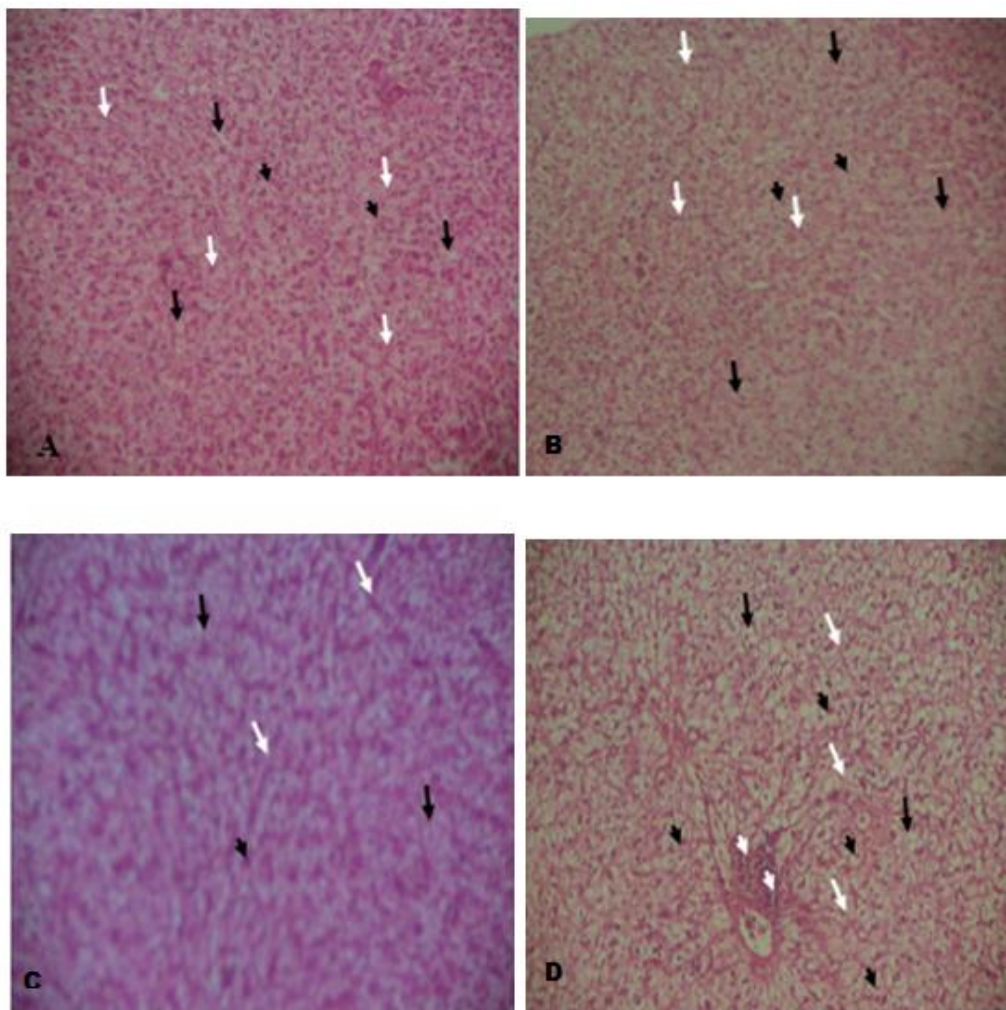


Plate 2: Light micrographs of the liver of *Clarias gariepinus* Exposed to Sub-lethal Concentrations of Aqueous Crude Stem Bark Extract of *Albezia gummifera* HandE A: X100.

A. Control (0.00 mg/L): showing normal morphology as shown by hepatocytes presenting with their characteristic polygonal shape, with nuclei (black arrowheads) surrounded by vacuoles (black arrows). The cellular demarcations (white arrows) appear intact.

B. 0.10 g/L, showing normal morphology as shown by hepatocytes presenting with their characteristic polygonal shape, with nuclei (black arrowheads) surrounded by vacuoles (black arrows). The cellular demarcations (white arrows) appear intact.

C. 0.20 g/L, showing mild atrophy as seen by the increase in interstitial spaces (black arrows). The cellular demarcations (white arrows). Black arrowhead cell nuclei are slightly thickened.

D. 0.30 g/L, showing inflammation as seen by the presence of inflammatory cells (white arrowheads) within the tissue. There is tissue atrophy as seen by the increase in interstitial spaces (black arrows). The cellular demarcations (white arrows) are slightly thickened. The nuclei (black arrowheads) are severely shrunk.

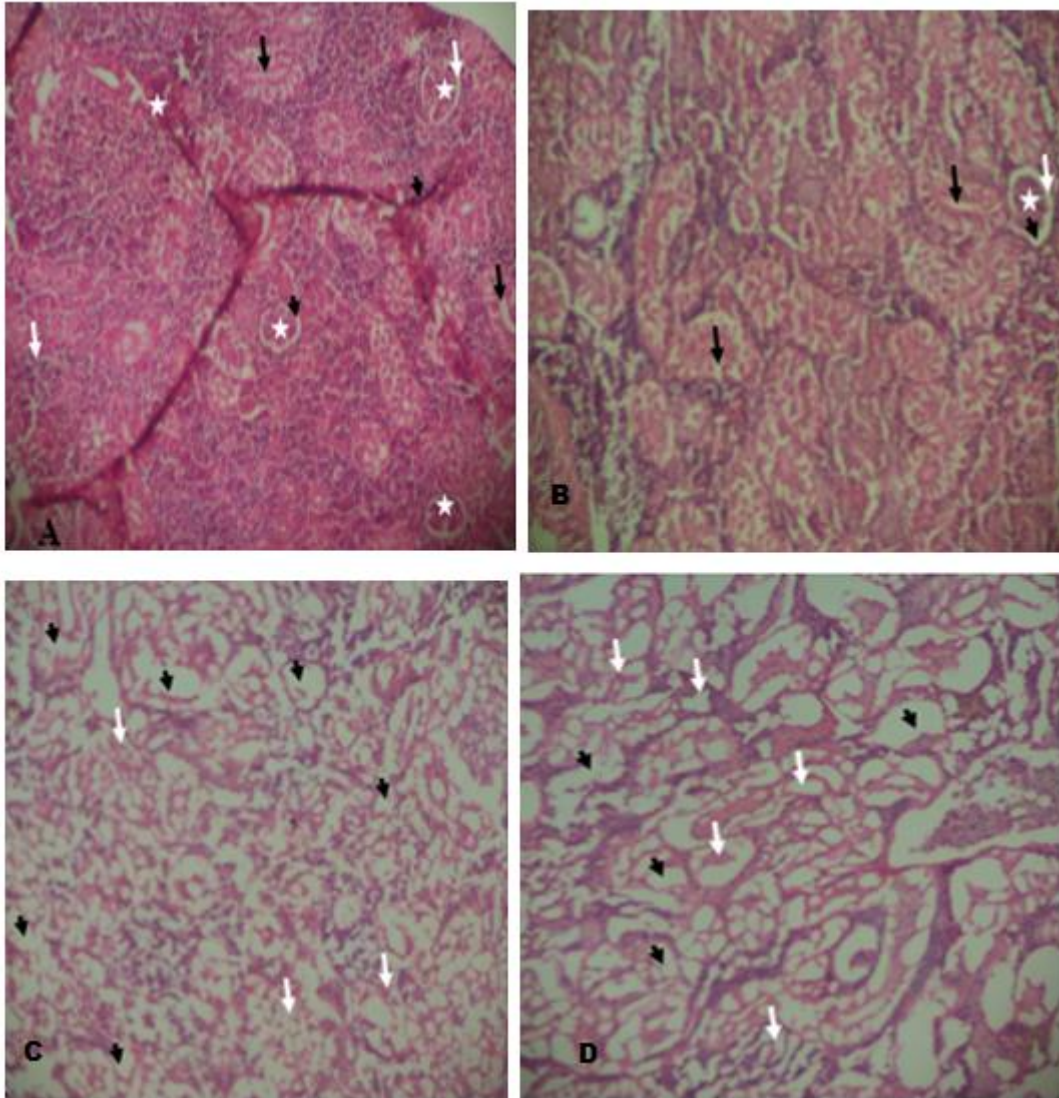


Plate 3: Light micrographs of the Kidney of *Clarias gariepinus* Exposed to Sub-lethal Concentrations of Aqueous Stem Bark Extract of *Albizia gummifera* HandE **A:** X100.

A. Control (0.00 mg/L), showing normal morphology as shown by the presence of intact glomeruli (white stars), surrounded by a clear zone of capsular space (black arrowheads). The glomerular capsule (white arrows) is intact.

B. 0.10g/L, showing normal morphology with mild hypertrophy as seen by the reduction in interstitial spaces. Glomerulus = white star, black arrows= tubule, white arrow= glomerular capsule, black arrowhead= capsular space.

C. 0.20g/L, showing atrophy as evident by the increase in interstitial spaces (black arrowheads) and degeneration (necrosis) as seen by the loss of cellular materials (white arrows).

D. 0.30g/L, showing atrophy as evident by the increase in interstitial spaces (black arrowheads) and degeneration (necrosis) as seen by the loss of cellular materials white arrows)

Plate 4: Light micrographs of the ovaries of *Clarias gariepinus* Exposed to Sub-lethal Concentrations of Aqueous Stem Bark Extract of *Albezia gummifera* HandE A: X100.

A. Control (0.00 mg/L): showing normal morphology. Perifollicular cells=Black arrowheads. White arrowheads=vitelline envelope, Black arrows = vitellogenic follicles, White arrows=previtellogenic oocyte, and Black stars = vitellogenic oocyte (Plate 4A).

B. 0.10g/L: showing normal morphology. Perifollicular cells=Black arrowheads. White arrowheads=vitelline envelope, Black arrows= vitellogenic follicles, White arrows= previtellogenic oocyte, and Black stars= vitellogenic oocyte (Plate 4B).

C. 0.20g/L: showing normal morphology with atrophied perifollicular cells (Black arrowheads). White arrowheads=vitelline envelope, Black arrows= vitellogenic follicles, White arrows=previtellogenic oocyte, Black stars= vitellogenic oocyte (plate 4C).

D. 3.00g/L: showing atrophy as seen by the presentation of increased interstitial spaces and shrunken perifollicular cells = Black arrowheads. The previtellogenic oocyte (White arrows) and

vitelline envelope (White arrowheads) are greatly reduced in size and there is a loss of vitellogenic oocyte. Black arrows= vitellogenic follicles (Plate 4D).

Testis of African Catfish exposed to 0.00g/L back extract of *A. gummifera*, showed normal morphology as presented by a clear distinction between the interstitial compartment (white arrowheads) and the Germinal compartment which contains the Spermatozoa (white arrows). Black arrows=basement membrane (Plate 5A). Testis of African Catfish exposed to 0.10 and 0.20 g/L back extract *Albezia gummifera*, showing normal morphology (Plate 5B and 5C). Testis of African Catfish (*Clarias gariepinus*) exposed to 0.30g/L back extract of *Albezia gummifera*, showing severe atrophy and massive tissue degeneration. There is a massive loss of spermatozoa and the seminiferous tubules (white arrows) appear empty, with pockets of spermatozoa (white arrowheads) presenting in a few of the seminiferous tubules, some of which are condensed. Black arrows = basement membrane (Plate 5D).

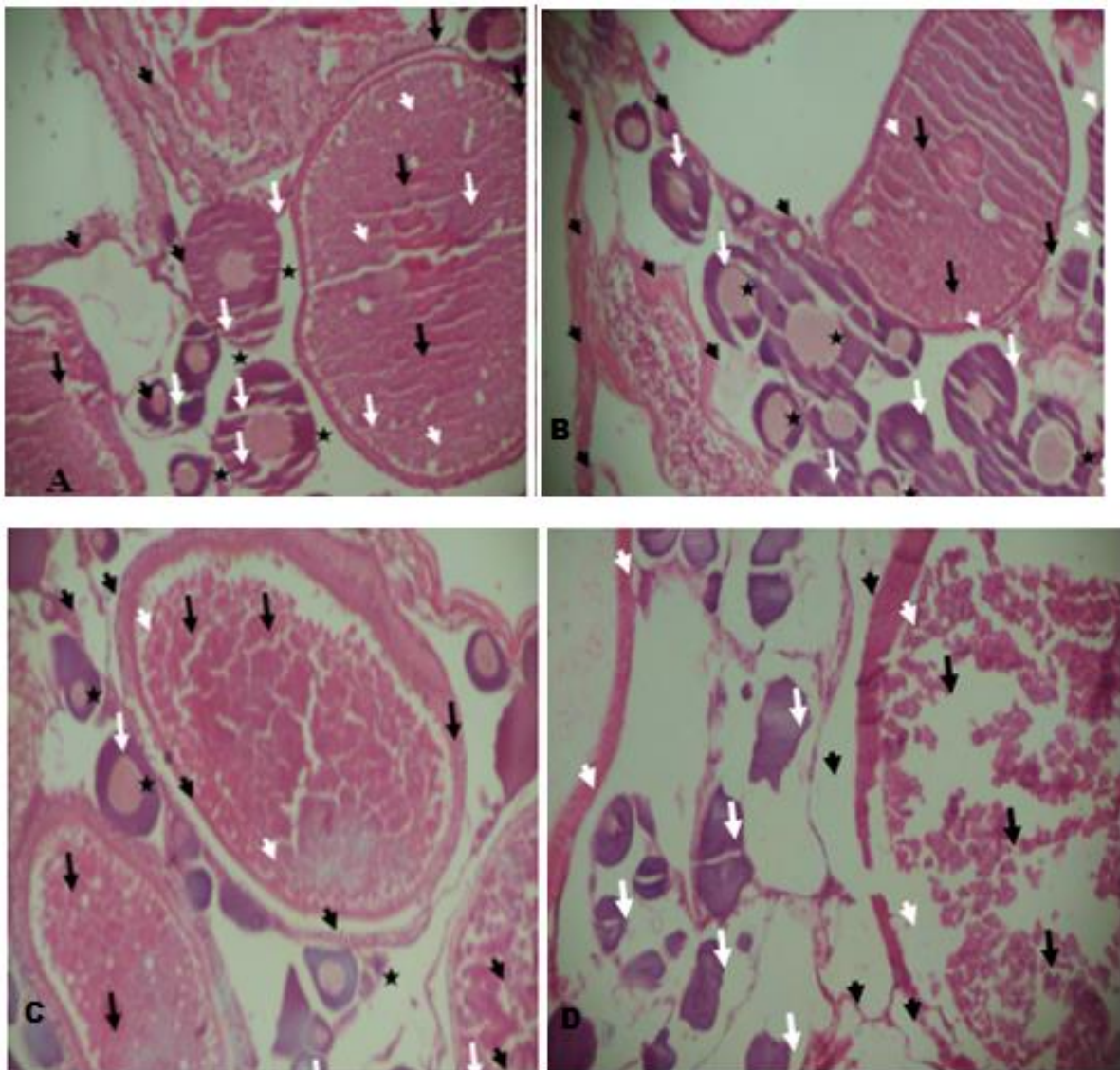


Plate 3: Light micrographs of the Ovaries of *Clarias gariepinus* Exposed to Sub-lethal Concentrations of Aqueous Stem Bark Extract of *Albezia gummifera* HandE A: X100.

A: control 0.00g/L; showing normal morphology. Perifollicular cells=Black arrowheads. White arrowheads = vitelline envelope, Black arrows = vitellogenic follicles, White arrows = previtellogenic oocyte, Black stars = vitellogenic oocyte. HandE A: X100

B. 0.10g/L; showing normal morphology. Perifollicular cells=Black arrowheads. White arrowheads=vitelline envelope Black arrows= vitellogenic follicles, White arrows= previtellogenic oocyte, Black stars= vitellogenic oocyte.

C. 0.20g/L; showing normal morphology with atrophied perifollicular cells (Black arrowheads). White arrowheads=vitelline envelope Black arrows= vitellogenic follicles, White arrows= previtellogenic oocyte, Black stars= vitellogenic oocyte.

D. 0.30g/L, showing atrophy as seen by the presentation of increased interstitial spaces and shrunken perifollicular cells = Black arrowheads. The previtellogenic oocyte (White arrows) and vitelline envelope (White arrowheads) are greatly reduced in size and there is a loss of vitellogenic oocyte, Black arrows= vitellogen

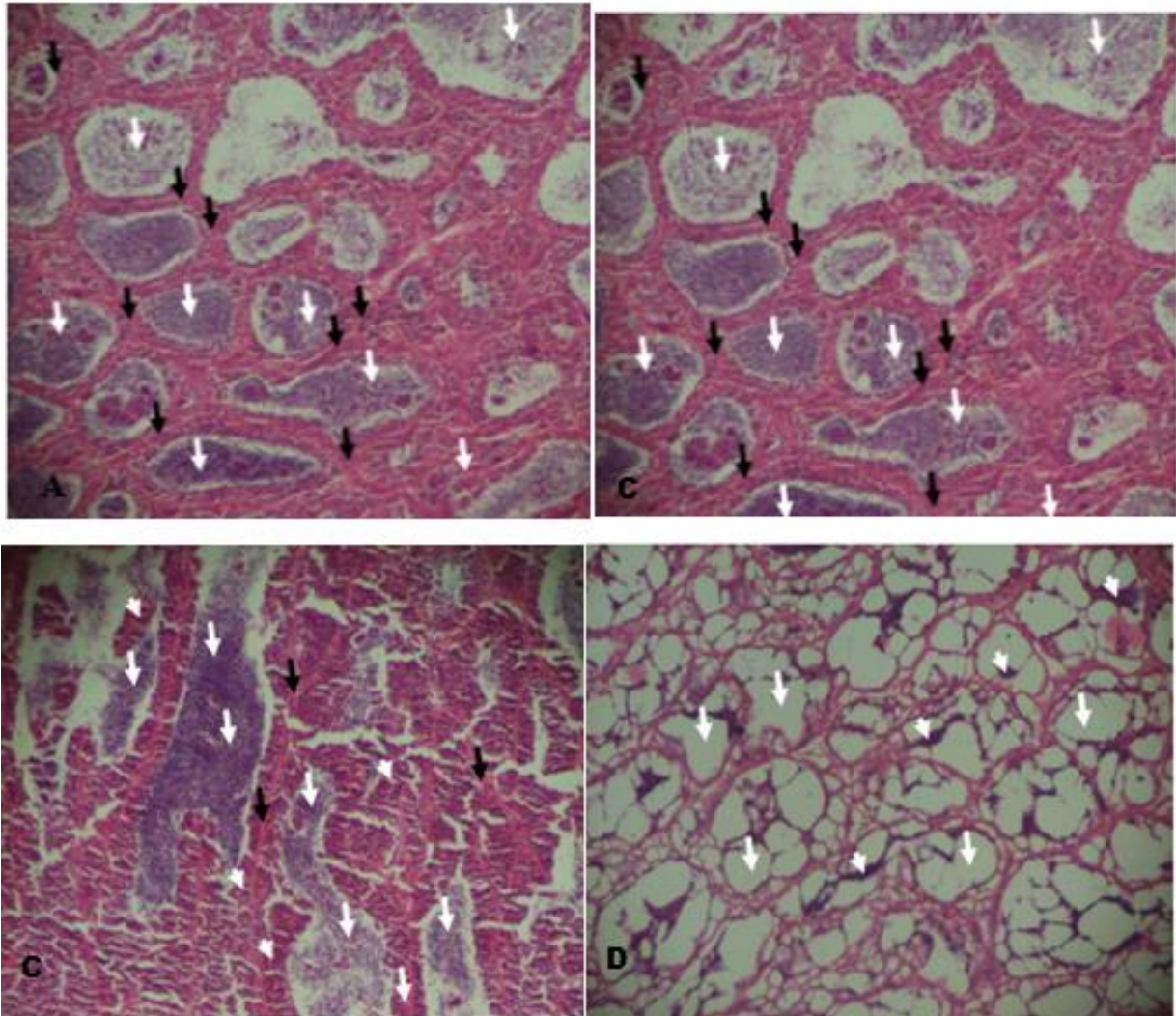


Plate 5A: Testis of African Catfish exposed to 0.00g/L back extract of *Albezia gummefira*, showing normal morphology as presented by a clear distinction between the interstitial compartment (white arrowheads) and the Germinal compartment which contains the Spermatozoa (white arrows). Black arrows=basement membrane HandE A: X100.

Plate 5B: showing normal morphology as presented by a clear distinction between the interstitial compartment (white arrowheads) and the Germinal compartment which contains the Spermatozoa (white arrows). Black arrows = basement membrane HandE A: X100 B: X400.

Plate 5C: 0.20g/L, showing normal morphology as presented by a clear distinction between the interstitial compartment (white arrowheads) and the Germinal compartment which contains the Spermatozoa (white arrows). Black arrows = basement membrane HandE A: X100 B: X400.

Plate 5D: 0.30g/L, showing severe atrophy and massive tissue degeneration. There is a massive loss of spermatozoa and the seminiferous tubules (white arrows) appear empty, with pockets of spermatozoa (white arrowheads) presenting in a few of the seminiferous tubules, some of which are condensed. Black arrows= basement membrane HandE A: X100

Discussion

Examining histological changes in tissues of fishes caused by toxicants is critical in understanding the health condition of the fish in their environment. In the current studies, there is no alteration in all the studied tissues (gills, liver, kidney, ovaries and testes) of the fish from the control tanks. Fishes exposed to various sub-lethal concentrations of the plant extracts showed different alterations as the concentration of the plant extracts increased.

Gills are effective indicators of water quality due to their extensive surface area and direct exposure to the external environment (Strzyzewska *et al.*, 2016). In Pisces, gills are important organs for respiration, osmoregulation and excretion (Velmurugan *et al.*, 2009). Contaminants in the water can affect the gills, leading to structural changes and impairment in their functionality (Marina 2023).

The results of this study showed alterations such as severe atrophy of secondary lamellae, slightly atrophied midline cartilage and primary lamellae were observed in fish gills exposed to lower sub-lethal concentrations of aqueous bark extract of *A. gummifera*, but the effects increased with increase in the plant extracts, such as complete loss of secondary lamellae. It can be speculated that these significant alterations compared with the control, may be attributed to the high content of bioactive compounds such as saponins, alkaloids, and flavonoids in *Albizia* extracts (Kamble *et al.*, 2019; Yadav *et al.*, 2021). Similar alteration such as severe atrophy of secondary lamellae was reported in the gills of fish exposed to *Azadirachta indica* (Miller *et al.*, 2021). Atrophy and loss of secondary lamellae were observed in the gills of fish exposed to *Nictiana tabacum* (Gonzalez *et al.*, 2020) which is similar to alterations caused by *A. gummifera*.

The liver, being the key organ responsible for detoxifying toxicants (Rodrigues *et al.*, 2019), undergoes significant structural changes when fish are exposed to toxic substances (Rodrigues and Fanta, 1998). Any structural damage in the liver can serve as a biomarker indicating previous exposure to pollutants in the environment (Dutta *et al.*, 1993). Exposure to sub-lethal concentrations of aqueous bark extract of *A. gummifera* resulted in mild atrophy, cell nuclei are slightly thickened, presence of inflammatory cells, slightly thickened cellular demarcations and nuclei are severely shrunken. According to (Gonzalez *et al.*, 2020) there were increased inflammatory cells, notable nuclear alterations and atrophy in the liver of fish exposed to *Ricinus communis* extracts which are consistent with the alterations seen with *A. gummifera* extracts. Johnson and Lee (2019) observed comparable histological damage of inflammatory cells, atrophy of liver tissues and shrunken and thickened nuclei after exposing fish to black pepper extracts which align with hepatic damage observed in this research.

The kidney is a vital organ in fish that functions as the main excretory system and is essential for regulating osmotic balance (Dorlikar and Mohite 2019). Catfish juveniles exposed to sub-lethal concentrations of aqueous bark extract of *A. gummifera* result in significant changes such as hypertrophy, atrophy and necrosis in their kidney compared to the control. Alterations such as tissue necrosis and tissue atrophy were reported in the kidney of *Oreochromis niloticus* exposed to Leaves of *Balanites aegyptiaca* (Wakawa and Audu, 2020). Vacuolation, hydropic degeneration,

and necrosis were also reported in the kidney of *C. gariepinus* exposed to a sub-lethal dose of *M. cajuputi* leaf extract (Marina *et al.*, 2023).

African Catfish exposed to the highest concentrations of bark extract of *A. gummifera* showed severe atrophy and massive tissue degeneration. There is massive loss of spermatozoa and the seminiferous tubules appear empty, with pockets of spermatozoa presenting in a few of the seminiferous tubules, some of which are condensed. Severe sloughing off of the seminiferous tubular boundary tissue and severe depletion of seminiferous luminal content was reported by (Sulaiman *et al.*, 2022) after exposing catfish to sublethal concentrations of *V. amygdalina* which is in line with the findings of this research. Priya and Balu (2013) reported severe deterioration, congestion of blood vessels and proliferation of interstitial tissues and vacant spaces enlarged the histology of the testis fish (*Rasbora dandia*) after 30 days of exposure to mercury which is not in line with this research work. The results of this work are not similar to the findings of (Claramma and Radhakrishnan, 2016) who reported histopathological changes such as distortion of seminiferous tubules, disorganization of spermatogonia, spermatocytes and spermatids with cytoplasmic vacuolization and nuclear pyknosis after exposing *Clarias batrachus* to sub-lethal concentrations of chromium for a period of 45 days.

Ovarian damages observed in the female gonad showed a trend of increased frequency of ovaries with atrophy and shrunken perfollicular cells, the previtellogenic oocyte and vitelline envelope are greatly reduced in size and there is loss of previtellogenic oocyte. Histopathological investigation indicated that the abnormalities in the female gonads may have contributed to the deformities in the egg structures and viability (Samuel *et al.*, 2021). Gonad lesions observed could have resulted in the degenerative ovarian changes of *C. gariepinus* exposed to sub-lethal concentrations of crude extracts of *A. gummifera*. The ovary displayed vacuolations, flabby oocytes, and degenerated ovary changes after exposure to lambda-cyhalothrin (Samuel, Emmanuel, Gregory, Bright and Ogonna, 2021) which is not similar to the finding of this research.

Conclusion

The present investigation revealed that the sublethal concentrations of *A. gummifera* crude bark extracts could be toxic to aquatic organisms. It significantly causes histopathological changes in the vital organs like gills, liver, kidney and gonads (ovaries and testes) of *C. gariepinus* which may alter the physiology and reduce fertility; consequently, it may result in some reproduction problems in the exposed fish. Reducing the use of ichthyotoxic plants by artisanal fishermen will minimize the decline in economically important fish.

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