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Effect of Crude Oil Water Soluble Fraction Toxicity on *Tilapia Guineensis* Fingerlings Using Histology of the Kidney as a Bioassay Indicator

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Abstract

Histological studies is well established as a fundamental relationships between pollutants and exposure to living organisms. The various biological responses and changes observed with such histological alterations can be used as a tool to detect toxic effects of pollutants in the organs of living organism making it a good environmental stressor indicator for bioassay. *Tilapia guineensis* fingerlings were collected at acute toxcity and after 98 days recovery period. Bonny-light crude oil (BLCO) and Benin River crude oil (BRCO) Water soluable fraction (WSF) were used as pollutant with different concentration from 0.00, 0.25%, 0.55%, 0.85% and 1.25% for acute toxicity and recovery period. The kidney tissue samples of the fish at acute toxicity (4 days) and recovery period (98 days) was collected for different WSF concentration, fixed, and sectioned. The histological sections of 5µg thickness of each sample were prepared and fixed on slide. This was observed (M x 400) under a light microscope (Olympus Model QC pass 02) linked to ACER LCD monitor with an Integrated Digital Scope photo (Model DCM 35). The experiment showed that crude oil water soluble fraction (WSF) as a the pollutant resulted in cytoplasmic vascuolation of the epithelial cells, leading to degeneration of the cytoplasm and enlarged tubule of the kidney of *Tilapia guineensis* fingerlings for both BLCO and BRCO as concentration increased. The 98 days recovery period showed larger increase in cytoplasmic vacuolization of the kidney cytoplasm tissue for both crude oil WSF. The effect of Bonny-light and Benin River crude oil on the kidney of *Tilapia guineensis* showed true reflection of effect of pollution with swelling of the renal tubules. The response of the kidney tissue of *Tilapia guineensis* as observed in this work is an indication that *Tilapia guineensis* is a good candidate for bioassay test serving as a pollution indcator species.

Keywords: Water soluble fraction toxicity; Kidney bioassay indicator; *Tilapia guineensis*

Introduction

Crude oil can be lethal in acute or chronic levels though these may manifest later which can lead to high mortality of the aquatic communities due to toxic chemicals in the crude oil and its water soluble fraction (WSF) [1]. They can cause loss of equilibrium, increased biological activities and irregular movement and eventually death in fish. These crude oil toxicants find their way into the body system of aquatic animals (Fishes) during oil spill or leakages through the gills, digestive tract and general body surface causing significant damage to the internal organs and tissues [2]. Histological studies have been used to establish fundamental relationships between contaminants exposure, various biological responses and changes to target fish organs in the laboratory [3]. Works by some authors show that histological alterations are sensitive tools that can be used to detect the direct toxic effects of various compounds on different organs making it a good environmental stressor indicators for bioassay [3-5]. The main techniques used in the detection of histo-pathological damage caused by toxic agents include the infusion of the sample in historesin or paraffin, followed by coloration with hematoxilin and eosin or other stains following a standard method. Fish exposed to pollutants such as crude oil WSF similarly cause histopathological changes in different tissues and organs such as gills, liver, kidney, spleen [6]. These histological changes vary depending on the stressor and the intensity of the toxic agent; The histological alteration found in fish tissue is well documented [7,8]. This paper highlights the use of histology of the kidney as an effective toxicity indicator for pollution studies and indicator.

Materials and Methods

Sample of kidney tissue of *Tilapia guineensis* fingerlings was collected at the beginning of the experiment and after 98 days recovery period for histology studies. The fingerlings sampled were sacrificed and kidney tissues collected using sterile forceps and transferred to sterile tubes. The kidney tissue samples of acute toxicity (4 days) and recovery period (98 days) were collected and fixed for sectioning within 24 hours in formalin-saline solution made of equal volumes of 10% formalin and 0.9% NaCl solution for histology studies [9]. The histological sections of 5µg thickness of each sample were prepared following standard procedures for the slide preparation and section by Dick [1]. The kidney tissue samples were embedded in paraffin wax and serial section of 5 µm thickness were de-paraffinised, stained in haematoxylin and counterstained with eosin. The fixed slide were observed (Mx400) under a light microscope (Olympus Model QC Pass 02) linked to ACER LCD monitor with an integrated digital scope photo (Model DCM 35) in Nigerian Institute for Oceanography and Marine Research: Aquaculture Department; Algae laboratory, Lagos.

Results and Discussion

The histological study conducted show that crude oil water soluble fraction (WSF) resulted in cytoplasmic vascuolation of the kidney tissue of *Tilapia guineensis* fingerlings compared with the normal (Plate 1).

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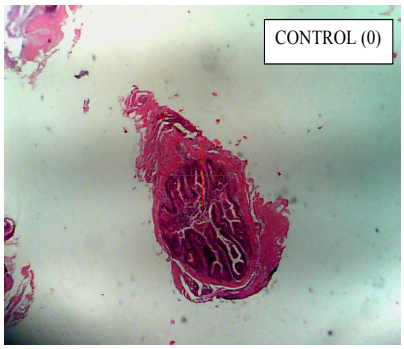

Plate 1: Histological section (Mx400) of normal kidney (control) of *Tilapia guineensis* fingerlings.

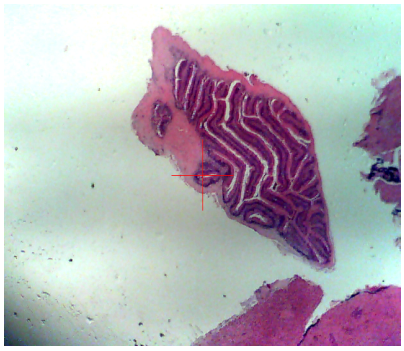

Plate 2: Histological section (Mx400) showing cloudy swelling of renal tubule in BLCO 11(0.25%).

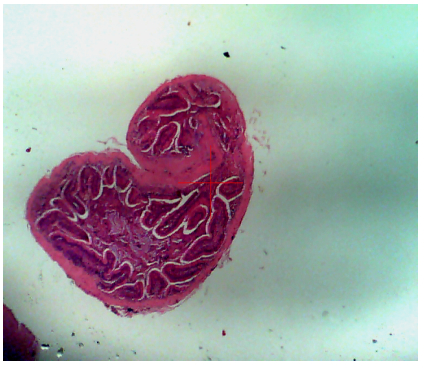

Plate 3: Histological section (Mx400) showing cloudy swelling of renal tubule in BRCO 11(0.25%).

The fundamental relationship between contamination, exposure and biological response of fish is established this was similar in both crude oil WSF in this work [10]. The kidney tissue samples of *Tilapia guineensis* fingerlings at acute toxicity (96 hours) for both BLCO and BRCO all showed similar characteristics. The kidney micro-photoscope showed swelling of the renal tubules and clear vacuolation of the epithelial cells leading to degeneration of the cytoplasm, enlarged tubule and shrinkage which is observed as concentration increased (Plates 2-5). The two crude oil; WSF also caused gradual cell tissue disintegration of the kidney which varied with increase in concentration for both BLCO and BRCO; this is welll observed (Plates 6-9). The 98 days recovery period showed larger increase in cytoplasmic vacuolization of the kidney tissue for both crude oil WSF (Plates 8 and 9) [11]. These were all similar in characteristics during the 98 days period.

Conclusion

The use of histology for toxicity bioassay is well established as indicated on the effect of Bonnylight and Benin River crude oil WSF on the kidney of *Tilapia guineensis*. The kidney tissue shows true reflection of effect of pollution with swelling of the renal tubules and clear vacuolation of the epithelial cells leading to degeneration of the cytoplasm. Enlarged tubule and disintegration of the cells/shrinkage observed as concentration increased is an indication that *Tilapia guineensis* kidney is a good organ for bioassay test serving as pollution indicator.

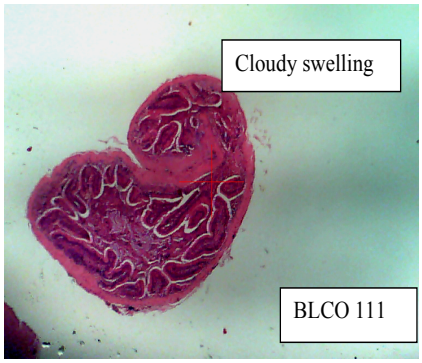

Plate 4: Histological section (Mx400) showing increased cloudy swelling of renal of renal tubule in BLCO 111(0.55%).

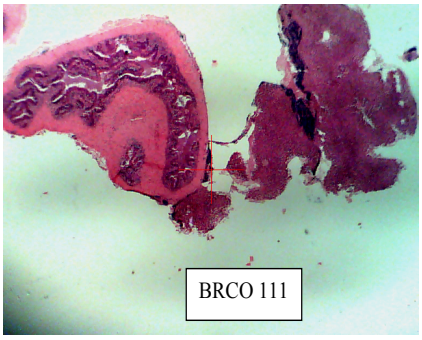

Plate 5: Histological section (Mx400) showing increased cloudy swelling of renal of renal tubule in BBCO 111(0.55%).

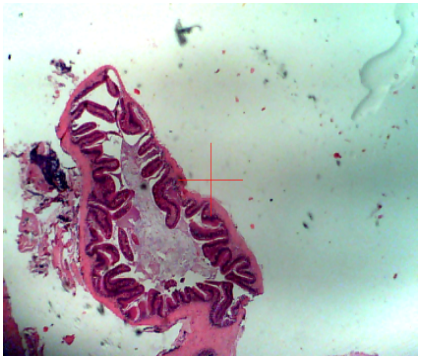

Plate 6: BLCO 1V: Histological section (Mx400) showing vacuolation of epithelial cells of renal tubules due to degeneration of the cytoplasm and enlarged tubule in BLCO 1V (0.85%).

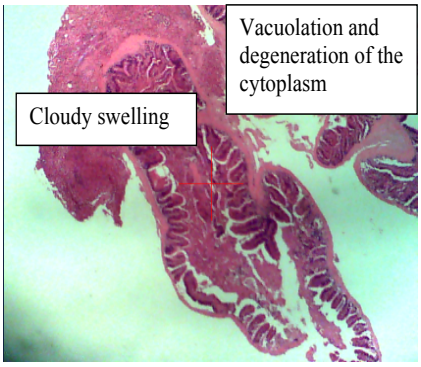

Plate 7: BRCO 1V: Histological section (Mx400) showing vacuolation of epithelial cells of renal tubules due to degeneration of the cytoplasm and enlarged tubule in BRCO 1V (0.85%).

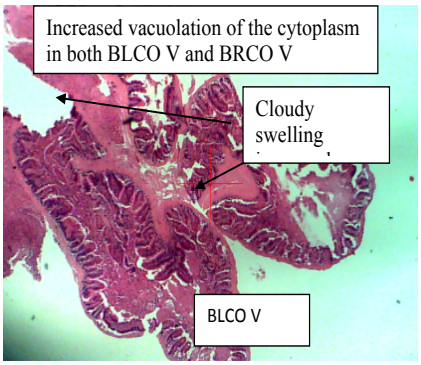

Plate 8: BLCO V: Histological section (Mx400) showing increased vacuolation of epithelial cells of renal tubules due to degeneration of the cytoplasm and enlarged tubule in BLCO V (1.15%).

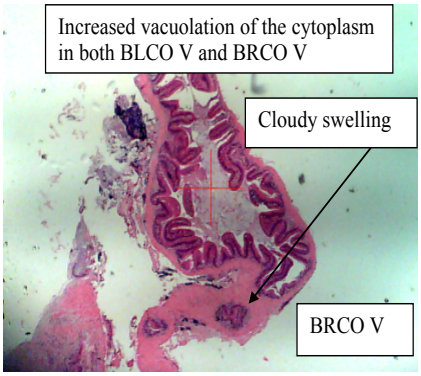

Plate 9: BRCO V: Histological section (Mx400) showing increased vacuolation of epithelial cells of renal tubules with shrinkage observed due to cloudy swellings in BRCO V (1.15%).

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