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Histopathological Study of the Effects of Lethal Concentration of Oil-Based Mud (Obm) on the Amphibious Fish of the Niger Delta Basin in Southern Nigeria

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Abstract: The histopathological study of the effects of lethal concentration (10, 8, 4, 2 and 0%, respectively) of Oil-Based Mud (OBM) on the fingerlings of the amphibious fish of the Niger Delta, *Periophthalmus barbarus* were exposed for 96 h using static bioassay. Histological study of liver, kidney, muscle, intestine, brain and gills were the tissue parameters investigated. Samples of tissues were preserved in formaldehydes for histological studies. Result revealed noticeable changes in tissues that ranged from mild to severe damage. Normal situation was observed in all the examined tissues of fish from the control (0%) tanks. The oil-based mud was toxic to the tissues examined.

Keywords: Drilling mud, histology, mangrove, *Periophthalmus barbarus*, toxicity

INTRODUCTION

Concern has grown in recent years because of the increase in oil activities from Nigerian Petroleum Industry and the treatment and disposal of operational material such as drilling mud into our environment (Ifeadi *et al*., 1985). The Niger Delta area in Nigeria are end owned with numerous natural resources such as oil and gas in the subterranean formation which can be recovered by drilling wells that penetrate the formation (World Oil, 2004). The well is drilled down using drilling mud (GESAMP, 1993). The damage done to the environment is irreversible as reported by Omoregie and Ufodike (1999) using the fingerlings of Nile tilapia to study the effects of crude oil exposure on growth, feed utilization and food reserves. The toxic nature of synthetic drilling mud (XP-07) has been highlighted by Vincent-Akpu and Sikoki (2006), when they worked on the effects of synthetic drilling mud on *Tilapia guineensis*. The toxicity of oil and water-base drilling mud on 11 marine invertebrates has been investigated by Neff *et al*. (1981). Oil-based mud have been reported by Mckee *et al*. (1995) to be toxic on microalgae, a copepod, a bivalve mollusc and a benthic amphipod. The histological effects of the exposure of *P. barbarus* to lethal concentrations of OBM have been studied in this study. Other workers of this species in the mangrove swamps of Niger Delta include, King and Udo (1996), Udo (2000) and Etim *et al*. (2002). The major objective of the present study therefore is to evaluate the effects of Oil-Based Mud (OBM) on the tissues (liver, kidney, muscle, intestine, brain and gills) of the amphibious fish of the Niger Delta, *Periophthalmus barbarus*.

MATERIALS AND METHODS

The fingerlings of *P. barbarus* weighing less than 9 g were obtained from the mangrove shores of Rumuche River in Emohua Local Government area in Port Harcourt, Rivers State in the Niger Delta area using trap nets at low tide. They were transported in air buckets in the late hours of the day to the hydrobiology/Fisheries Biology laboratory, University of Port Harcourt, Choba, Nigeria and placed in holding tanks where they were acclimated for 7 days. In the laboratory, the fish were fed twice daily with 3% body weight of NIOMR feed (35% Crude Protein). Lethal concentrations of 2, 4, 8 and 10%, respectively OBM were prepared following standard methods and the bioassay lasted for duration of 96 h. The control (0%) had no OBM and 24 h prior to the bioassay, the experimental fish were stopped feeding and throughout the test, the fish were starved. The temperature, pH. Dissolved oxygen and salinity were monitored throughout the duration of the experiment following the methods described by APHA (1998). At the end of the experiment, one fish from each concentration of the three replicates was sacrificed by cutting the head with a knife. Samples of gills, brains, muscle, intestines and kidneys were taken from each group of bioassay (concentration) as well as sample from the control for histological analysis. Care was taken not to squeeze any of the tissues and they were processed by methods according to Golder (2007) and Wester *et al*. (2003).

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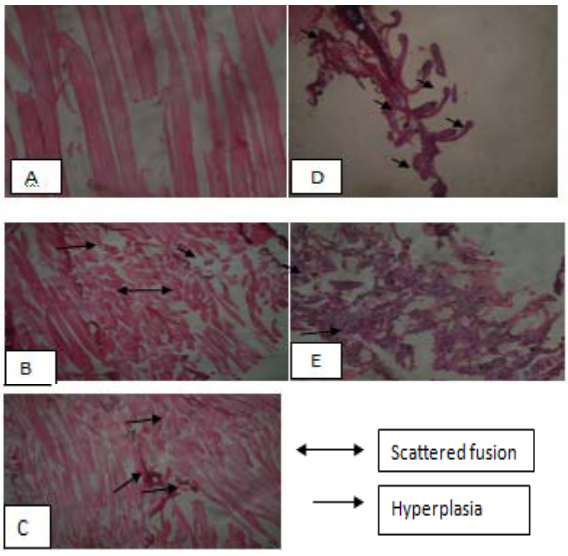

Fig. 1: Photomicrographs of gill filament of *P. barbarus* exposed to oil-based drilling mud after 96 h exposure (X100), (A) Control: Normal, (B) 2%: Epithelial lifting, (C) 4%: Secondary epithelial lifting, (D) 8%: Disruption of lamella, (E) 10%: Severe disruption of lamella

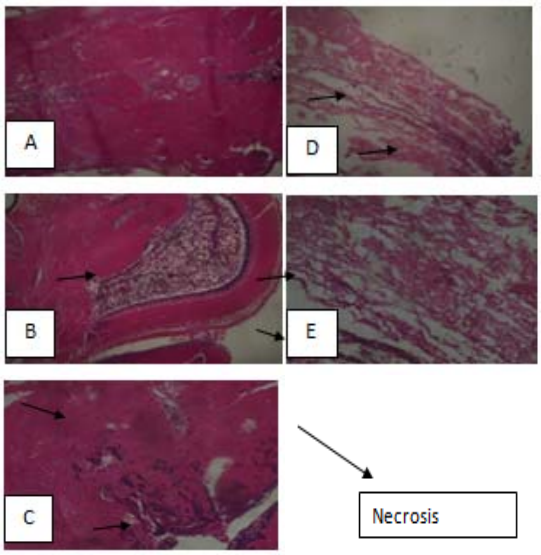

Fig. 3: Photomicrographs of kidney of *P. barbarus* exposed to oil-based drilling mud after 96 h exposure (X100), (A) Control: Normal cell, (B) 2%: Mild macrophage, (C) 4%: Severe macrophage, (D) 8%: Necrosis of cell, (E) 10%: Severe disruption and necrosis of cell

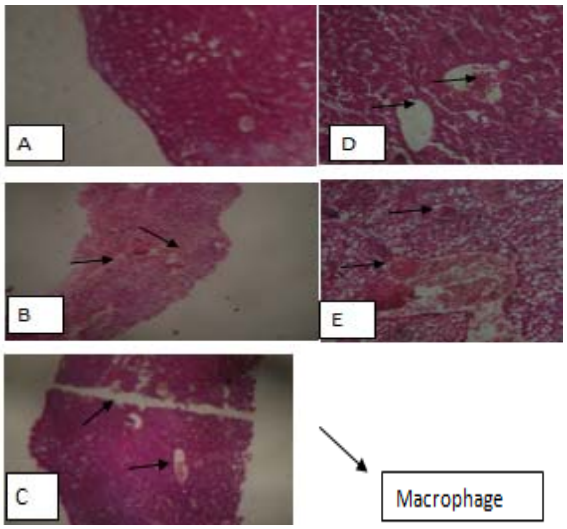

Fig. 2: Photomicrographs of liver of *P. barbarus* exposed to oil-based drilling mud after 96 h exposure (X100), (A) Control: Regular and normal cell shape, (B) 2%: Cell shrinking, (C) 4%: Mild vacuolation, (D) 8%: Mild phagocytosis, (E) 10%: Severe coagulative lesion

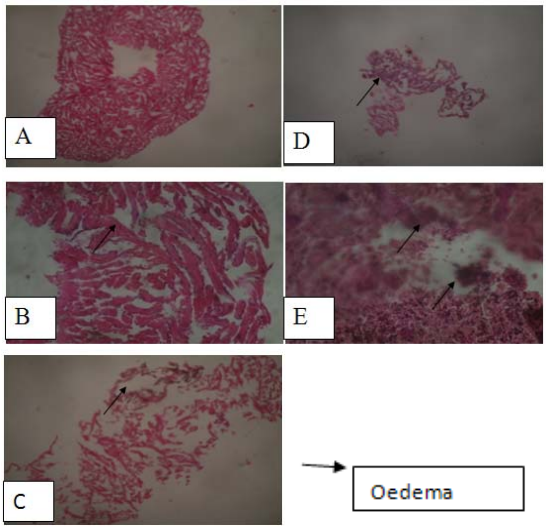

Fig. 4: Photomicrographs of brain of *P. barbarus* exposed to oil-based drilling mud after 96 h exposure (X100), (A) Control: Normal brain cell, (B) 2%: Mild inflammation, (C) 4%: Severe inflammation, (D) 8%: Oedema of cell, (E) 10%: Severe cytomas of cell and oedema

RESULTS

After 96 h of exposure to OBM, for the control, the gills, livers, kidneys and intestines had no discernible changes. The color of the gills was red, normal parallel arranged gill filaments (Fig. 1). The liver cells, brain and muscle tissues, kidney and intestines were in shape, no vacuolation, no macrophage and remained arranged (Fig. 2 to 6). Lethal concentration of OBM from 2 to 10% showed mild to severe variations of cells. There was disruption of the gills with evidence of hyperplasia of the gill lamella, epithelial lifting and erosion. Mild to severe vacuolation was seen in the liver cells and necrosis. Thickening of the walls of the blood vessel with increase in interstitial fibrous tissue, macrophage

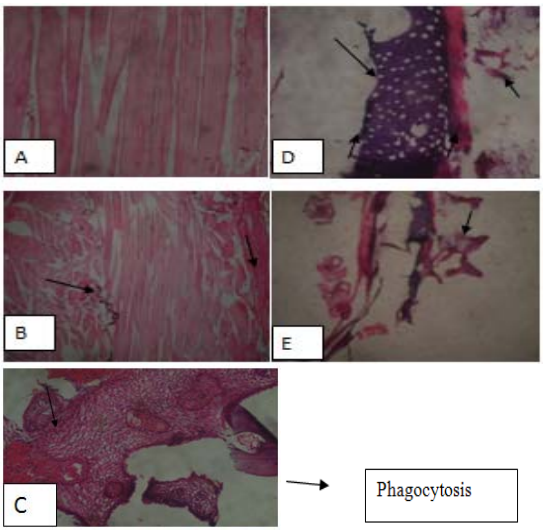

Fig. 5: Photomicrographs of muscle of *P. barbarus* exposed to oil-based drilling mud after 96 h exposure (X100), (A) Control: Normal muscle cell, (B) 2%: Mild vacuolatioin, (C) 4%: Mild phagocytosis, (D) 8%: Severe cell disruption, (E) 10%: Severe phagocytosis

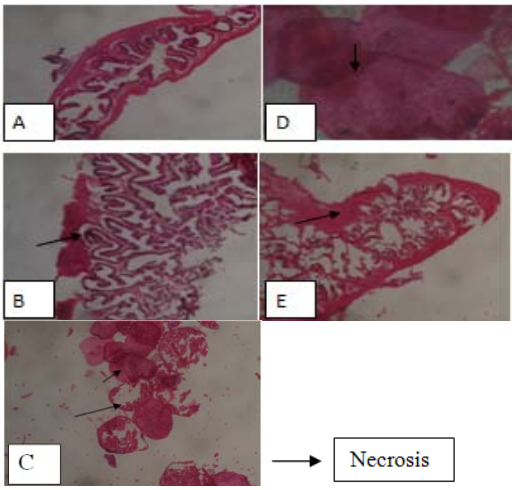

Fig. 6: Photomicrographs of small intestine of *P. barbarus* exposed to oil-based drilling mud after 96 h exposure (X100), (A) Control: No obvious change, (B) 2%: Mild necrosis, (C) 4%: Necrosis of epithelial, (D) 8%: Severe necrosis, (E) 10%: Loss of fatty tissue

was observed at the cells of the kidney exposed to 10% OBM. The exposed brain cells were inflamed with edemous fluid at concentrations 8 and 10%. Loss of fatty tissues and extensive loss of digestive glands were more pronounced in the cells of the intestines with hypoplasia of intestinal glands.

DISCUSSION

The histopathological studies of changes of tissue from exposure fish to OBM had shown widespread damage. This particular histological result on the liver cells was similar to those observed by earlier workers, (Van Dyk, 2003; Wester *et al*., 2004; Laurence, 1975). The exposure of fish kidney to the toxicant revealed changes and the presence of macrophage were similar to the observation by OGP (2006) and Bhuiyan *et al*. (2001). Sastry and Siddqui (1982) reported disrupted intestinal glucose transport in the intestine and oedematous fluid in the sub mucosa of the intestinal walls as histopathological changes commonly observed with *Channa punctatus* exposed with endosulfan.

In conclusion, this research highlights the fact that lethal concentrations of OBM have toxic effects on the tissues of *Periophthalmus barbarus*. Therefore, its disposal to swamps and mangrove shores will need proper control to avoid reduction in our amphibious fish and aquatic fauna.

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