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Effect Of Effluent From Port Harcourt Refining Company On Hepatic and Reproductive Functions Of Wistar Albino Rats.

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Abstract

Many waste effluent substances have recently been demonstrated to have a toxic effect on the hepatic function. This study investigated the effect of effluent from the Port Harcourt Refining Company on the hepatic and reproductive function of wistar albino rats. The effluent was rated to be toxic based on the WHO maximum permission limit of PAH, TPH, THC in effluents. The effluent was administered to the rats for a period of 14 days. The rats showed symptoms of dullness, bulging of eyes, lacrimation and shivering. Hormonal and hepatic function test showed significant increase ($P<0.05$) in ALT, AST, ALP, FSH, LH and testosterone levels, indicating impaired reproductive hormonal function and hepatotoxicity. The histological examination of the hepatic cells indicated that the effluent induced proximal degeneration of the integrity of the hepatic cells, inflammation, hepatocyte degeneration, partial architectural distortion and hemorrhage.

Keywords: Effluent, Hepatotoxicity, Reproductive Hormonal function, Histological examination.

1. Introduction

The Niger Delta region is surrounded by water which serves as a means of livelihood to the people, hence the need for a proper analysis on the water to ascertain its level of pollution as the water bodies serves as a discharge point to the Refining Company.

The Petroleum Refinery and Petrochemical Industries are most desirable for national development and improved quality of life, however the unwholesome and environmentally unacceptable pollution effects of the wastes from these industries are cause for worry (World Bank,1998).

The waste water released from the refineries are characterized by the presence of large quantities of crude oil products, polycyclic and aromatic hydrocarbons, phenols, metal derivatives, surface active substances, sulfides, naphthalene acids and other chemical. As a result of ineffectiveness of purification systems, waste water may become seriously dangerous leading to the accumulation of toxic products in the receiving water bodies with potentially serious consequences on the ecosystem (Suleimanov,1995).

(Odinga et al.,2015) reported that the effluent from Port Harcourt Refining Company contained levels of Polycyclic Aromatic Hydrocarbon, Total Hydrocarbon, and Total Polycyclic Hydrocarbon, indicating the presence of Hydrocarbons in the effluent.

The uncontrolled disposal of effluent into water bodies renders water unsafe for economic use, recreational use and poses a threat to human life and also against the principle of sustainable development (Oluwande *et al.*, 1993). Drinking contaminated water can cause various diseases such as typhoid fever, dysentery, cholera and other gastro-intestinal diseases, hence the need for a safe water as human beings are made up of water in roughly the same percentage as water on the surface of the earth and water is essential for the development and maintenance of the dynamics of every ramification of the society.

2. Materials and methods

2.1 Effluent sample

The effluent sample was obtained from the Port Harcourt Refining Company plant at Alesa-Eleme, Rivers State of Nigeria in opaque bottles.

2.2 Water sample

Borehole water was collected in opaque bottles from a residential house in Agip estate in Port Harcourt, Rivers State, Nigeria.

Both effluent and water samples were kept in the refrigerator and used within the shortest possible time to avoid microbial activities which may likely affect oxygen content.

2.3 Experimental animals

Fifteen wistar albino rats weighing between 163-180g of about three months old, bred in the Animal House of the Department of Biochemistry, University of Port Harcourt were used for this study. The animals were housed in metabolic cages and fed with commercially sold feed as food and water was given *ad libitum*.

2.4 Experimental protocols

The rats were randomly assigned into 3groups of 5rats each and the experiment lasted a period of 14days.

Group 1 Animals were fed with normal rat chow and water *ad libitum* throughout the period of the experiment. On the 13th day, 0.2ppm standard solution of polycyclic aromatic hydrocarbon was administered to each rat in the group intraperitoneally.

Group 2 Animals were fed with feed and effluent water *ad libitum* throughout the period of the experiment.

Group 3 Animals used as control were fed with borehole water and feed *ad libitum* throughout the period of the experiment.

All experimental animals were sacrificed on day 14 of the experiment.

2.5 Collection of blood and liver sample

On day 14 of the experiment, animals were anaesthetized with chloroform vapor and whole blood was collected by direct cardiac puncture from each animal into labeled ice-cold lithium heparinized bottles and centrifuged.

The animals were dissected, the liver were collected for histopathological examination.

DATA ANALYSIS

Results are expressed as mean ± standard deviation, and all data were subjected to analysis of variance (ANOVA) and significant difference between the treatments means were detected at 5% confidence level.

3. Results and discussion

Table 1: Effect of PAH & Refinery effluent on hepatic function of wistar albino rats

GROUP	ALT(U/I)	AST(U/I)	ALP(U/I)
Group 1 (PAH)	15.00±0.82^{a}	15.25±1.50^{a}	101.05±16.64^{a}
Group2 (effluent)	6.40±1.14^{b}	6.40±0.55^{b}	63.32±5.44^{b}
Group3borehole(control)	3.60±1.82^{c}	4.00±0.00^{c}	38.68±6.39^{c}

- *Values are mean ± standard deviation*
- *Values in the same column with different superscript are*

Significantly different at the 0.05 level ($P \leq 0.05$).

The values show significant variations among groups 1, 2, and 3. at 0.05 levels ($P \leq 0.05$) in the hepatic cells after the administration of the Refinery Effluent and PAH. It shows a progressive increase in the level of the biomarkers of the Liver ALT(15.00>6.40>3.60), AST(15.25>6.40>4.00), ALP(101.05>63.32>38.68) for PAH, Refinery Effluent and borehole water respectively with PAH having the highest level of hepatic damage . Interperitoneal administration of PAH resulted to death of one animal in group 1 which indicates damage to the hepatic cells.

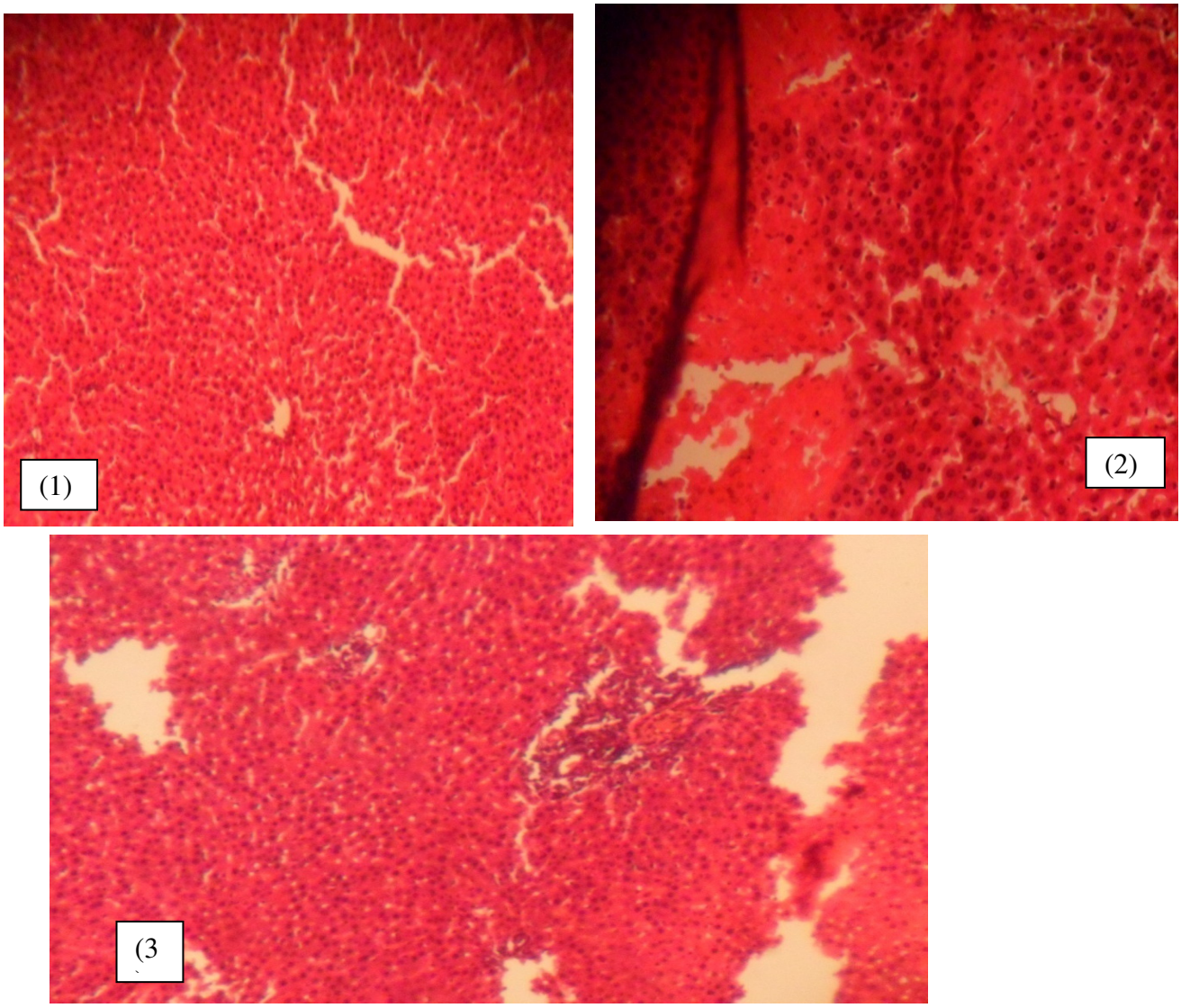
Table 2: Effect Of PAH And Refinery Effluent on Reproductive Function

GROUP	**Testosterone(ng/ml)**	**FSH (MIU/ml)**	**LH (MIU/ml)**
Group 1 (PAH)	1.90±0.18[a]	1.15±0.13[a]	1.33±0.25[a]
Group2 (effluent)	2.04±0.11[a]	1.12±0.13[a]	1.20±0.26[a]
Group3 borehole (control)	2.46±0.24[b]	1.94±0.13[b]	1.78±0.23[a]

- *Values are mean ± standard deviation*
- *Values in the same column with different superscript are significantly different at the 0.05 level ($P \leq 0.05$).*
- *Values in the same column with the same superscript are not significantly different at tho 0.05 level. ($P \leq 0.05$).*

The values shows significant variations between the groups administered with effluent and borehole (control) with a progression decrease, indicating a decrease in the activity of the reproductive hormones (testosterone, FSH and LH).

Photomicrographs of liver of wistar albino rats of groups 1, 2 and 3.



H&E X400

Fig. 1 **:** (1) A section of control rat liver showing normal architecture. (2) A section of rat liver exposed to effluent showing inflammatory cells, architectural distortion, hemorrhage. (3) A section of liver exposed to PAH showing degenerating changes and expanded sinusoids.

The hepatic markers monitored to check for the effect of PAH and effluent are the activity levels of ALT, AST and ALP. These are markers of hepatocyte organelles that leak out into the circulation in response to injury caused by reactive metabolites resulting from xenobiotic metabolism in the liver. The result shows that increase were observed in the concentration of ALT, AST and ALP as PAH and effluent water samples were administered to the rats. The result shows a progressive increase from group 3 (control) to group one (PAH) with significant increase at the 0.05 level ($P \leq 0.05$). This shows that the PAH had the most effect on the liver leading to severe liver damage with inflammatory cells of the liver. In comparism with the control (group 3), the effluent was also seen to have damaging effects on the hepatic cells. These damages could be attributed to the presence of PAH & other chemicals found in the effluent water sample as a result of the crude and chemicals

used in the refining process (Odinga et al.,2015). Table 2 shows the result of the effect of effluent and PAH on the reproductive function. The result shows variation in the values of testosterone, FSH and LH among the groups with significant difference between the effluent group and the borehole group (control) ($p \leq 0.05$). This indicates a toxic effect on the reproductive hormones thus a decrease in the activity of the reproductive hormone which can lead to infertility.

There was observed loss in body weight in the groups of the experimental animals and a death of an animal in group one (PAH) was also recorded. Other symptoms observed in the animals were shivering, bulging of eyes, lacrimination. There was no recorded gain in body weight. This loss in weight maybe attributed to the presence of hydrocarbons, trace elements and other pollutant parameters present in the samples administered to the rats, which has been found to be toxic to the health. (Mc Cain et al, 1978) reported enhanced weight loss of animals which supports the findings in this work.

The histopathological study of the liver showed marked infiltration of the portal triads by lymphocytes, hemorrhage, hepatocyte degenerations, and architectural distortion. Sinusoids in most cases were distended and central veins appear severely damaged due to marked swelling and degeneration of the endothelial lining cells.

4. Conclusion

The result generated from this study suggests that the effluent water from Port Harcourt Refinery is capable of causing hepatic damage and failure due to the presence of Hydrocarbons and other chemicals found in it and also has the potency of decreasing the reproductive function.

LIST OF ABBREVIATION

AST- Aspartate Aminotransferase

ALT- Alanine Aminotransferase

ALP- Alkaline phosphatase

PAH- Polycyclic aromatic hydrocarbon

ANOVA- Analysis of Variance

FSH- Follicle Stimulating Hormone

LH- Luteinizing Hormone

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