



Impact of Elioizu Port Harcourt Landfill Leachate on Some Reproductive Hormones in Female Wistar Rats

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Authors' contributions

This work was carried out in collaboration among all authors. Author GIK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author OKV managed the analyses of the study. Author WII managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Pollution of water sources by leachate and the toxicity that ensues have been reported globally. However, there is still need to evaluate its effects on reproductive hormones; considering the influence of environment on reproduction and the increasing number of infertility cases in the society. In this study therefore, the effect of landfill leachate at Elioizu in Port Harcourt Nigeria on some female reproductive hormones were evaluated using Wistar rats as experimental model. Twenty-five rats were grouped divided into five groups with five rats each. Group 1 served as control and received 1 ml of commercially bottled water, group 2 received 1ml of water from borehole about 1 km from the landfill; while groups 3, 4 and 5 received 1ml of 10%, 50% and 100% concentrations of leachate once daily for 30 consecutive days. All administrations were through oral gavage and animals were handled in line with guidelines for experimental animal care and handling. At the end

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of 30-days administrations, the animals were anaesthetized and about 4 ml of blood was collected through cardiac puncture; serum obtained was used to determine the serum concentrations of follicle stimulating hormone (FSH), luteinizing hormone (LH), prolactin, progesterone and estrogen. Results showed that leachate exposure at various concentrations caused a significant decrease in FSH, LH and prolactin $p \leq 0.05$; and a significant increase in progesterone and estrogen compared with the control group $p \leq 0.05$. This study therefore concludes that leachate could alter female reproductive hormones.

Keywords: Prolactin; progesterone; estrogen; leachate; follicle stimulating hormone; luteinizing hormone.

1. INTRODUCTION

Municipal solid waste (MSW) disposal constitutes environmental challenge globally [1]. Landfilling and /or open dumping is the preferred method of waste disposal in developing countries due to lack of suitable technology [2,3]. This therefore could lead to environmental pollution and health risk to immediate community; because liquid containing significant concentration of undesirable materials may drain from the stock piled materials and contaminate under ground water or nearby water sources. The water that drains from the stockpile of dumpsites is regarded as leachate; it may contain toxic compounds that may collate in water bodies and make them toxic to the body when taken [4-6]. Studies have reported that leachates samples of Aba-Eku landfill in Lagos and Elioizu landfill in Port Harcourt Nigeria, contain heavy metals and microbes [7,8]. The study also reported that exposure to landfill leachate and (or) drinking water from a nearby source may cause significant hepatological toxicity in Wistar rats [8]. Also, haematological toxicity has been reported in solid waste workers in Port Harcourt Nigeria; which was attributed to exposure to chemicals in solid wastes [9].

Among the factors that may cause infertility in women is environmental factors which interferes with the hormones that regulate reproductive functions. In reproduction however, the main endocrine glands are the anterior pituitary gland which secretes the luteinizing hormones (LH) and the follicle stimulating hormones (FSH). The gonad (ovary) secretes estrogen and progesterin [10]. The secretory functions of these glands are under the control of the hypothalamus that secretes the gonadotropin releasing hormones (GnRH) [10]. Interference with any of these hormonal responses may contribute to infertility. The biological systems such as the reproductive system is affected by environmental factors like

pollutants [11]. Some earlier reports stated that exposure to leachate cause the decrease in gonado-somatic index value and shrinking oocyte diameter of female Nile Tilapia [12]. There is however scanty literature on the effect of any Port Harcourt landfill leachate on female reproductive hormones; hence, the need for this study that aimed at evaluating the impact of Port Harcourt Elioizu landfill leachate on some female reproductive hormones female Wistar rat model.

2. MATERIALS AND METHODS

2.1 Collection of Leachate

Raw leachate fluids were collected from leachate well at Elioizu landfill in Port Harcourt, Nigeria. The leachate sample was taken to the laboratory in a clean and dry 4-liter plastic containers, where it was filtered using Whatmann No. 42 filter paper to remove suspended particles. The filtrate was centrifuged at 3000 rpm using Techmel and Techmel USA (model: 80-2) for 10 minutes and the supernatant fluid obtained was considered as stock samples (100%) and labeled as Port Harcourt (Elioizu) landfill leachate (PELL) and stored at 4°C. The following concentrations were thus determined, 10%, 50% by dilution of the leachate with distilled water.

2.2 Experimental Animals

Twenty-five female Wistar rats weighing about 170 g were obtained from the animal house unit of Faculty of Basic Medical Sciences, University of Port Harcourt, Nigeria. The animals were acclimatized for 14 days under standard laboratory conditions of 12-hour dark and light cycle with free access to drinking water and standard rodent chow *ad libitum*. The animals were treated according to the guide for the Care and use of laboratory animals

2.3 Experimental Design

The rats were randomly assigned into five groups of five (5) rats each. Group 1 served as a control and orally received 1 ml of commercially bottled water, group 2: Orally received 1 ml of water from a borehole close to the landfill. Groups 3, 4 and 5 received 1 ml of 10%, 50%, and 100% leachate concentrations orally for 30 days. At the end of the leachate administration, the rats were anaesthetized using chloroform vapour and blood samples immediately collected through cardiac puncture. Serum was obtained from the blood samples and used for the determination of the experimental parameters (FSH, LH, Estrogen, progesterone and prolactin).

2.4 Assay of the Reproductive Hormone

Follicle stimulating hormone (FSH), luteinizing hormone (LH), Progesterone, Prolactin and estrogen quantitative test were based on a solid phase enzyme-linked immunoabsorbent assay (ELISA) [13,14], with kits from ACCU BIND, USA. The samples were read in Microplate reader (SM 300A) from Surgifield Medical, England.

2.5 Statistical Analysis

Data obtained from the study were statistically analyzed using SPSS version 20.0. One-way analysis of variance (ANOVA) was used to compare the means of the various groups with significant difference set at a $p \leq 0.05$.

3. RESULTS

At the end of the study, mean values of results in each group are presented Table 1. Groups 1 and 2 were the positive and negative controls respectively while groups 3, 4 and 5 were the

test groups receiving various concentrations of the leachate.

4. DISCUSSION

In the present study, we observed statistically significant decrease in follicle stimulating hormone (FSH) and luteinizing hormone (LH) amongst the animals exposed to Port Harcourt Elioizu landfill leachate (PELL). FSH level is decreased as concentration of leachate is increased. However, estrogen and progesterone levels were observed to increase as the concentration of leachate increased. Theoretically, as FSH level increases, size of follicle increases which will increase the secretion of estrogen and progesterone. This observation is similar to report of lower concentration of FSH and LH among welders who were exposed to lead fumes with concentrations higher than recommended values [15]; but contradicts a study that reported increase in the level of FSH on auto-mobile technicians in Ibadan Nigeria [16]. The difference could be as result of disparity in leachate constituents [17]. The significant decrease in the serum level of prolactin in the experimental groups compared to the control group is similar to an earlier report that cadmium exposure inhibits prolactin secretory response to thyrotrophic releasing hormone (TRH) *in vitro* [18]. Also, studies have reported that methylmercury inhibits prolactin release in cell line of pituitary origin [19]. Therefore, the possible presence of mercury in leachate may be responsible for inhibiting the pituitary cells. The observed significant increase in the serum concentration of progesterone and estrogen in the experimental groups when compared to the control group is similar to the reported studies on monkeys exposed to lead and rats exposed to cadmium [17,20].

Table 1. Effect of Port Harcourt (Elioizu) landfill leachate on female reproductive hormones

Parameters	Group-1 (commercially obtained bottled water)	Group-2 (nearby borehole water)	Group-3 (10% PELL)	Group-4 (50% PELL)	Group-5 (100% PELL)
Follicle stimulating Hormone (m/u/ml)	0.75±0.00	0.63**±0.60	0.70±0.35	0.17*±0.01	0.11*±0.01
Luteinizing Hormone (m/u/ml)	2.15±0.20	1.23**±0.04	1.21*±0.05	0.29*±0.02	0.19*±0.01
Prolactin (ng/ml)	4.90±0.28	3.22**±0.03	1.41*±0.03	0.38*±0.02	0.20*±0.01
Progesterone (ng/ml)	2.67±0.02	4.30**±0.12	5.33*±0.13	7.02*±0.18	8.90*±0.06
Estrogen (pg/ml)	50.20±0.37	53.6**±0.60	52.0±0.32	53.8*±0.60	56.0*±0.04

*= significant difference compared with group 1; **= significant difference compared with group 2. ($P \leq 0.05$)

5. CONCLUSION

This study therefore concludes that landfill leachate from Elioizu in Port Harcourt Nigeria or drinking water from sources close to landfills may cause alterations in female reproductive hormones of Wistar rats.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Ethical approval for this study was sought and obtained from the University of Port Harcourt research committee, with the approval reference number: UPH/R&D/REC/04. So, the study was performed in accordance with the ethical standards and guidelines for the care and use of laboratory animals.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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