wjpmr, 2024, 10(9), 49-53

SJIF Impact Factor: 6.842

WORLD JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.wjpmr.com

Research Article

ISSN 2455-3301

WJPMR

LEVEL OF SELECTED HEAVY METALS IN LAND SNAIL (*ACHATINA FULICA*) FROM OKOLOBIRI, A COMMUNITY EXPOSED TO PETROLEUM POLLUTION IN BAYELSA STATE

[1]*Ikimi C. G. and [2]Addy P. S.

[1]Department of Biochemistry, Faculty of Science, Federal University Otuoke, Bayelsa State, Nigeria.
[2]Department of Biochemistry, Faculty of Basic Medical Sciences, Bayelsa Medical University, Imgbi Road, Yenagoa, Bayelsa State, Nigeria.

***Corresponding Author: Ikimi C. G.**

Department of Biochemistry, Faculty of Science, Federal University Otuoke, Bayelsa State, Nigeria.

Article Received on 04/07/2024 **Article Revised on 25/07/2024** **Article Accepted on 15/08/2024**

ABSTRACT

This study centers on estimating the levels/concentrations of selected heavy metals (Fe, Zn, Cu, Cd, Pb and Ni) in land snails (*Achatina fulica*) obtained from Okolobiri and Odi communities both in Bayelsa state, Nigeria in other to assess the pollution status of the environment. The principal objective of this research was to determine the levels of heavy metal (Fe, Zn, Cu, Cd, Pb and Ni) contamination in land snails from Odi and Okolobiri, draw comparisons between there quantities in both locations, evaluate the toxicity risks associated with consumption of contaminated land snails sourced from Okolobiri using the levels of Fe, Zn, Cu, Cd, Pb and Ni as indicators, and also to determine the association between petroleum activities and food pollution in these areas. The heavy metal, constituents of the samples were determined using Atomic Absorption Spectrophotometer (AAS). Each sample was analyzed in triplicate and the mean calculated, thereafter the mean of all 3 samples were calculated. The results were expressed as mean ± std. Statistical analysis was performed on the data generated from the study using Microsoft Excel and SSPS software (version 18.10). Independent sample t-test was used to compare differences in the mean result of different sample groups and Pearson correlation analysis was used to determine the relationship between individual parameters. The results obtained shows a clear indication in the differences in heavy metals concentrations, with Okolobiri exhibiting consequentially higher levels of heavy metals compared to Odi. Statistical analysis confirms that the dissimilarities between these two locations are statistically significant. The strong positive correlation observed amongst the parameters within each location emphasizes a common source of contamination. In the same vein, the significant negative correlation between parameters in the control and test locations emphasizes the immense negative effect of petroleum contamination of the environment and most especially on food materials. It is therefore peremptory and mandatory to address the environmental and health concerns resulting from petroleum, and petroleum- related pollution in these regions. This study emphasizes the need for the establishment of firm legislations and improvements on the existing environmental legislations towards averting the impending dangers of petroleum pollution to human lives and the environment.

KEYWORDS: Heavy Metals, Fe, Zn, Cu, Cd, Pb, Ni, *Achatina fulica*, Okolobiri.

INTRODUCTION

Nigeria is one of the world's top oil producers because of the Niger Delta region, which is essential to the production of petroleum (Ibeanu, 2010). On the other hand, regular oil spills and the release of untreated wastewater into waterways have created serious environmental problems(Nriagu, 2012).

In the Niger Delta, petroleum contamination has long been a problem, leading to ecological imbalances and major dangers to the environment and public health (Obot et al., 2010). Petroleum and its derivatives deliver heavy metal contaminants, such as lead (Pb), cadmium (Cd), and nickel (Ni), into land and water bodies (Egbinola and Aigbedion, 2011).

Because heavy metals are known to linger in the environment and build up in living things, they can have a detrimental effect on ecosystems and general public health (Nriagu, 1996).

Land snails are very helpful as bioindicators for identifying heavy metal contamination in terrestrial ecosystems, claim Adewoye et al. (2017). They are perfect for researching the impacts of pollution because of their sedentary lifestyles and propensity to accumulate metals in their tissues (Ekpo et al., 2008). There is little information on heavy metal contamination in land snails in Nigerian regions impacted by petroleum pollution, despite the snails' important role in ecological systems and the possible health risks they provide when poisoned. By analyzing the quantities of particular heavy metals in land snails in a Nigerian town affected by petroleum pollution, this study seeks to close this knowledge gap. The results will contribute to a better understanding of the level of heavy metal contamination in this region and offer important insights for environmental management and public health.

METHODOLOGY

Study Area

In the Nigerian state of Bayelsa, Okolobiri is a rural village situated in the Yenagoa Local Government Area. With a population of over 20,000, it is essentially a riverine town located at 4.88540N, 6.07840E (oloko, 2020). The Okolobiri community has been plagued by oil contamination for a number of decades. Numerous oil spills that have harmed the local population's health and the environment have been caused by oil firms operating in the region. In 1969, an oil rig owned by the Shell Petroleum Development Company (SPDC) ruptured, causing a significant oil spill in the nearby lake, signifying one of the first cases of oil pollution in Okolobiri (Ezekiel-Hart et al., 2018). Since then, there have been other instances of oil pollution in the region, including sabotage, technical malfunctions, and pipeline breaches (Gobo, 2014). According to several research, the area's soil and water contain high concentrations of heavy metals and other harmful compounds, which can lead to a variety of health issues (Ezekiel-Hart et al., 2018; Gobo, 2014). The local wildlife, environment, and the general population have all suffered severely as a result of these oil spills (Gobo, 2014).

Sample Collection

In the study areas, land snails (*Achatina fulica*) were brought from local hunters who have been pre- informed. A total of six (6) samples were acquired, three (3) from each locations that is; three (3) from control site (Odi community) and three (3) from test site (Okolobiri community).

The acquired samples were stored in a glass jar with a glass stopper. The samples were taken to the Department of Biology, Federal University Otuoke for identification by zoologist.

Thereafter, the samples were then transported to the laboratory for processing and assay (Nkpaa *et al.,* 2013).

Sample Preparation

The samples were washed and rinsed with distilled water and then were sliced into smaller sizes and oven dried in an electrical oven at 80℃ for 72 hours and then homogenized into powdered form with mortar and pestle, sieved, weighed with an electronic weighing balance and stored in a glass jar with a glass stopper (ATSDR, 2001).

Sample Analysis

The following selected heavy metals (Fe, Zn, Cu, Pb, Cd, Ni) constituents of the samples were determined using Atomic Absorption Spectrophotometer (AAS) (Nkpaa *et al*., 2013).

This method involves two stages

i. Sample Extraction
ii. AAS Analysis

I. Sample Extraction

Grounded land snails (*Achatina fulica*) sample 2.0g was weighed into a 250ml conical flask and 15.0ml digested mixture of nitrate acid in the ratio of 1:2v/v was added. The resulting mixture was swirled and kept in the fume cupboard overnight. This was later digested at temperature of 150℃ on a hot plate for 25mins or until frothing case. At the end of the frothing, the samples were removed from the hot plate and boiled for 10mins after which 3.0cm³ of hydrochloric acid was added and further digested for another 30mins. The boiling tube was then removed from the hot plate and allowed to cool and the content of the tube was made up to 50.0cm³ with deionized water and transferred into a universal bottle.

II. Atomic Absorption Spectrometry (AAS) Analysis

The extracted solution were then measure and analyzed with AAS. The principle of AAS involves measuring the absorption of radiation by atomic vapour produced from the sample solution at wave length that is characteristic of the element being determined. During the analysis, the solution was aspirated into a flame which was irradiated by light from a hallow cathode lamp. The cathode which contains the element being determined, emitted light of wave length characteristic of the element. The atom of this element in the flame absorbed light and the degree of Absorption was proportional to the concentration of the element in the sample and this was measured spectrophotometrically and the concentration read automatically from the display unit.

Statistical Analysis of Result

Each sample was analyzed in triplicate, and the mean calculated. Thereafter, the mean of all three samples were calculated. The results were expressed as mean± standard deviation.

Statistical analysis was performed on the data generated from the study using Microsoft excel and SPSS software (version 15).

Independent sample t-test was used to compare differences in the mean result of different sample groups (difference between control location and site location) and correlation analysis was used to determine the relationship of the data with one another.

Ethical Clearance

Ethical clearance was obtained from the animal research ethics committee of the Federal University Otuoke, Bayelsa State, Nigeria. The Animal Welfare Act of 1985 of the United States of America for research and Institutional Animal Care and Use Committee (IACUC) protocols were stringently adhered to.

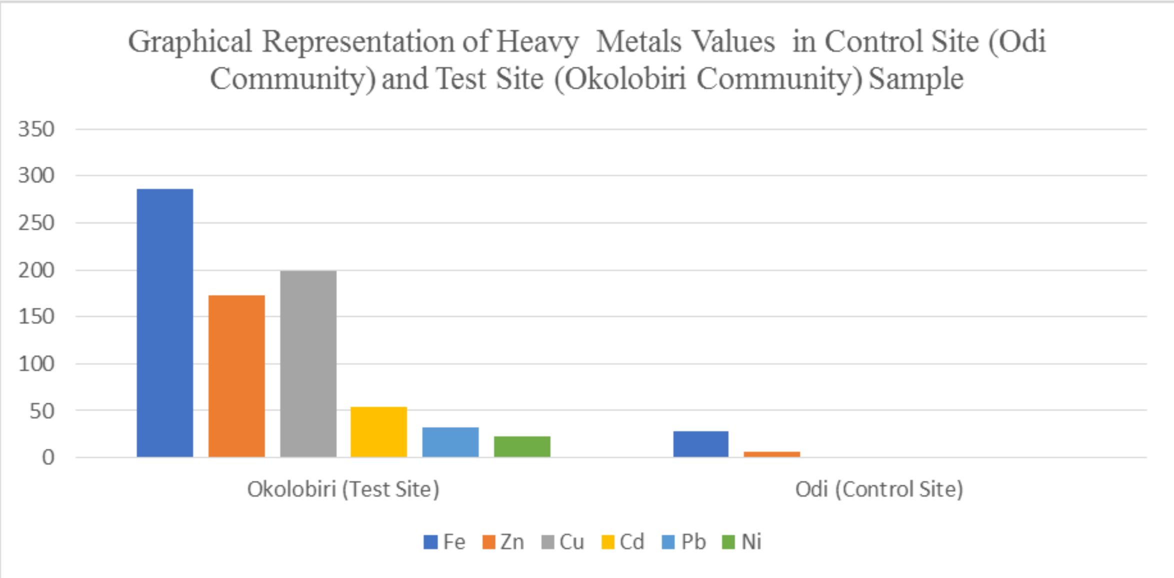
RESULT

The table below shows the mean values and standard deviation of Odi (control location) and Okolobiri (test location). The mean concentration levels of Fe, Zn, Cu, Cd, Pb and Ni Zn found in the snail samples were 286.13±0.002mg/Kg, 173.29±0.002mg/Kg, 198.32±0.002mg/Kg, 53.75±0.001mg/Kg, 31.53±0.001mg/kg and 22.36±0.001mg/kg respectively in Okolobiri and 28.20±0.041mg/kg, 6.63±0.082mg/kg, 1.19±0.730mg/kg, 0.01±0.110mg/kg, 0.13±0.66mg/kg and 1.17±0.005mg/kg in Odi respectively (Table 1).

Table 1: Heavy Metals In Land Snail (Mg/Kg).

Metals	Okolobiri	Odi (Control)
Fe	286.13±0.002	28.20±0.041
Zn	173.29±0.002	6.63±0.082
Cu	198.32±0.002	1.19±0.730
Cd	53.75±0.001	0.01±0.110
Pb	31.53±0.001	0.13±0.66
Ni	22.36±0.001	1.170±0.005

Results were expressed as mean ± standard deviation, independent sample T-test was calculated at 95% confidence interval and significant results at (P< 0.05). The mean difference is significant at 0.05 (P<0.05) and not significant at (P >0.05).



The result shows that there was a significant positive correlation among the result values of the parameters of heavy metals (Fe, Zn, Cu, Cd, Pb and Ni) at each study location. (Pearson correlation = 0.924, P< 0.05) while there was a significant negative correlation between the result values of parameters of heavy metals (Fe, Zn, Cu, Cd, Pb and Ni) at ODI (control location) and the result values of parameters at Okolobiri (test location) at P = -905, (P< 0.05)

DISCUSSION

The primary objective was to determine the concentration of heavy metals in snails in these locations.

Iron is a chemical element with the symbol Fe (CIAAW, 2024). It constitutes about 5% of the Earth's crust and is one of the most abundant metals. Iron is a crucial component of hemoglobin and myoglobin, the oxygen-carrying proteins in the blood and muscles, respectively, as well as cytochrome c, an electron-carrying mitochondrial protein (Lukaski, 2004). In this study, the iron concentration in Okolobiri was significantly higher than in the control site, Odi, with concentrations of 286.13 ± 0.002 in Okolobiri and 28.20 ± 0.041 in Odi. Excessive iron consumption or exposure can lead to conditions such as hemochromatosis, which can cause organ damage (Iron Disorders Institute, 2020)

Cadmium levels in the snail samples from Okolobiri were significantly elevated, measuring 53.75 mg/kg, which exceeds the standard limit of 0.3 mg/kg established by the FAO/WHO Codex (1984). In contrast, cadmium concentrations in the Odi community were below the detection limit, recorded at 0.01 mg/kg (Table 1). A study by Adedeji *et al.* (2011) reported a cadmium concentration of 0.01 mg/kg in snails collected from the Alaro River in the Oluyole industrial area of Ibadan, Nigeria, aligning with the levels observed in Odi. The cadmium concentration found in Okolobiri surpasses the maximum recommended limit set by the Codex Alimentarius Commission, posing potential health risks such as kidney dysfunction, skeletal damage, and reproductive issues for individuals consuming giant African snails from the Okolobiri community (Agusa *et* *al*., 2005). The elevated levels of cadmium may be attributed to the extensive oil pollution present in the area.

Lead is highly toxic to humans, with its most severe effects on the hematopoietic, nervous, reproductive systems, and the urinary tract. It has been documented that lead causes damage to human kidneys and liver (Sivaperumal *et al.*, 2007). The Food and Agriculture Organization/World Health Organization has set the maximum permitted level for lead at 1.5 mg/kg. In this research, the concentration of lead in the Okolobiri community was significantly higher than the WHO limit, measuring 31.53 mg/kg. In contrast, the lead concentration in the Odi community was below the detection limit, recorded at 0.13 mg/kg (Figure 1). Chukwujindu *et al.* reported lead levels ranging from 0.77 mg/kg to 7.51 mg/kg in giant African land snails (Archachatina marginata) from nine localities in southern Nigeria, which is still lower than the levels detected in the oil-polluted Okolobiri community.

Zinc levels in Okolobiri are significantly elevated compared to Odi. The Zn concentration in Okolobiri community was recorded at 173.29±0.002mg/kg which is significantly higher than 6.63±0.082mg/kg recorded at the control site. While zinc (Zn) is crucial for numerous bodily functions, excessive intake can lead to negative effects such as nausea, vomiting, loss of appetite, abdominal cramps, diarrhea, and headaches. Chronic consumption of 150–450 mg of zinc per day has been associated with serious health problems, including low copper levels, impaired iron function, and weakened immune function.

The concentration of copper in Okolobiri at 198.32±0.002mg/kg exceeds the WHO recommended level (Codex Alimentarius Commission (2011), indicating potential toxicity as compared to the concentration of 1.19±0.730mg/kg taken from the control site (Odi Community). High copper levels can cause gastrointestinal distress, liver and kidney damage, and other serious health issues. This suggests a significant health hazard in Okolobiri due to petroleum-related activities.

Nickel concentrations in Okolobiri are significantly elevated compared to Odi and both are above the daily recommended intake of the heavy metal. Chronic exposure to nickel can cause respiratory issues, skin dermatitis, and increased cancer risk. The elevated levels in Okolobiri indicate potential health risks due to prolonged exposure.

This study has successfully evaluated the association between petroleum activities and food pollution. The significantly elevated heavy metals level in Okolobiri community land snails compared to Odi's pristine environment as shown in Table 1 establish a clear link between petroleum exploitation and food contamination. As a potential food source, these snails serve as bioindicators of the broader environmental consequences of oil exploration. This study serves as a poignant reminder of the ecological costs associated with oil exploitation in regions heavily reliant on this industry, underlining the importance of sustainable practices and comprehensive monitoring to mitigate the pervasive impact of heavy metals contamination (Adedokun *et al*., 2021).

Pearson correlation analysis reveals valuable information about the relationships between the parameters. The significant positive correlation ($r = 0.924$, $p < 0.05$) among the result values of the parameters at each study location underscores the co-occurrence and interdependence of these heavy metals components. Furthermore, the significant negative correlation ($r = -0.905$, $p < 0.05$) between the result values of parameters at the test and control locations suggests an inverse relationship, signifying a distinct environmental influence at the test location.

CONCLUSION

In conclusion, this research not only highlights the severe environmental consequences of petroleum activities but also the pressing need to safeguard the food supply and public health of communities impacted by such practices.

REFERENCES

1. Adedeji, O.B., Adeyemo, O.K. & Oyedele, M.O. Heavy Metals in Snail and Water Samples from Alaro River in Oluyole Industrial Area of Ibadan Southwestern Nigeria. Journal of Applies Sciences in Environmental Sanitation, 2011; 6: 115-121.
2. Adedokun, A.H., Njoku, K. L., Akinola, M.O., Adesuyi, A. A., & Jolaoso, A.O. Heavy Metal content and the potential health risk assessment of some leafy vegetables cultivated in some floodplains and farmlands in Lagos, Nigeria. *FUNAI Journal of science & Technology*, 2017; 3(1): 30-47.
3. Adewoye, R. A., Okon, U.B., Adeleye, O. A., & Asuquo, E. N. Impact of crude oil pollution on the survivability of land snail in the Niger Delta, Nigeria. American Journal of Environmental Protection, 2017; 6(2): 32-38.
4. Agusa, T., Kunito, T., Yasunaga, G., Iwata, H., Subramanian, A., Ismail, A. & Tanabe, A. Concentrations of Trace Elements in Marine fish and Its Risk Assessment in Malaysia. Marine Pollution Bulletin, 2005; 51: 896-911. http://dx.doi.org/10.1016/j.marpolbul.2005.06.007
5. ATSDR. (2001). Toxicity of polycyclic aromatic hydrocarbons (PAHs). http://www.epagov/r5supr/ecology/html/toxprofiles.Html accessed 01-04-2017
6. Egbinola, O.A., & Aigbedion, J.0. Heavy metal accumulation in plants growing near an oil Refinery in Nigeria. *Journal of Environmental Protection*, 2011; 2(8): 482-487.

7. Ekpo, U. N., Adebayo, O. L. & Nganje, M. E. Snail as bioindicators of lead poisoning in contaminated soils, 2008.
8. Ezekiel-Hart, R., Isoun, M.T., Nathaniel, E. & Abulude, F. Environmental impact assessment of oil exploration and exploitation in Okolobiri Community, Bayelsa State, Nigeria. *Journal of Applied Sciences and Environmental Management*, 2018; 22(11): 1701-1706.
9. FAO/WHO (Food and Agriculture Organization/World Health Organization) List of Maximum Levels Recommended for Contaminants by the Joint FAO/WHO Codex Alimentarius Commission. Second Series. CAC/FAL, Rome, 1984; 3: 1-8.
10. Gobo, A.E. Oil exploration and environmental degradation in the Niger Delta region of Nigeria. *International Journal of Environmental Science and Development*, 2014; 5(5): 535-540.
11. Ibeanu, O. Environmental injustice, oil politics, and the Ogoni struggle for self-determination in Nigeria. *Human Rights Quarterly*, 2010; 32(2): 456-485.
12. Iron Disorders Institute, 2020. Hemochromatosis *(http://www.hemochromatosis.org/#overview).*
13. IUPAC Commission on isotopic abundances and atomic weight. Data source, 2024; 15673.
14. Lukaski, H.S. Vitamin and mineral status: effect on performance. *Nutrition*, 2004; 20: 632-644.
15. Nkpaa, K.W., Wegwu, M.O. & Essien, E.B. Assessment of polycyclic aromatic Hydrocarbons in two chemically important fish species from crude oil polluted waters of Ogoni land and their carcinogenic health risks. *Journal of Environment and Health Science*, 2013; 3(8): 1-10.
16. Nriagu, J.O. Environmental and human health impacts of heavy metals. *Science of the Total Environment*, 1996; 186(1): 63-112.
17. Oloko, J. (2020). Okolobiri: A community in search of social amenities. Vanguard news. http://www.vanguard.com/2020/06/okolobiri-a-community-in-search-of-social-amenities/
18. Sivaperumal, P.S., Ankar T.V. & Viswanathan Nair, P.G. Heavy Metal Concentrations in Fish, Shellfish and Fish Products from Internal Markets of India Vis-a-Vis International Standard. *Food Chemistry*, 2007; 102: 612-630. http://dx.doi.org/10.1016/j.foodchem.2006.05.041