Bioaccumulation of Polycyclic Aromatic Hydrocarbon (PAH) in Water and Aquatic Organisms in Lagos Lagoon, Nigeria

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Being a MSc Thesis Submitted to the Department of Biological Sciences, Faculty of Natural & Applied Sciences, Lead City University, Ibadan, Oyo State, Nigeria

In Partial Fulfilment of the Requirements for the Award of Masters of Science Degree (MSc) in Environmental Management and Toxicology

2025

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Certification

This is to certify that **Bisola Muinat FALEYE** with the matriculation number LCU/PG/005499, carried out this research work titled "Bioaccumulation of Polycyclic Aromatic Hydrocarbon (PAH) in Water and Aquatic Organisms in Lagos Lagoon, Nigeria" in the Department of Biological Sciences, Faculty of Natural and Applied Sciences, Lead City University Ibadan, Oyo State, for the award of Master of Science Degree (MSc) in Environmental Management and Toxicology and this has not been previously submitted.

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Dedication

This work is dedicated to the Glory of God Almighty, the Author and the Finisher of my faith, who has given me the strength and wisdom throughout this study.

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Even though the above-mentioned institutions and people have assisted in the process of this research work, I alone stand responsible for the errors, if any, found in the work.

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Abstract

Polycyclic aromatic hydrocarbons (PAHs) are a class of persistent organic pollutants that cause global concern due to their toxicity, mutagenicity, and carcinogenicity. This study examined the amounts of sixteen key PAHs in water and selected aquatic species (fish, crabs, and shrimp) from Lagos Lagoon, Nigeria, to determine the level of pollution, bioaccumulation, and potential health hazards. Samples were obtained from three lagoon sites with significant anthropogenic effect and compared to a selected control site beyond the direct impact zone. Standard techniques were used in laboratory analyses, and quantities were quantified before being analyzed statistically and for health risks. The results showed that all sixteen PAHs were detected in lagoon samples, but the control location had only insignificant or trace levels. Concentrations in water varied from 0.05 mg/kg for acenaphthylene to 18.89 mg/kg for benzo[g,h,i]perylene. Fish had the highest values of 17.86 mg/kg, crabs 17.23 mg/kg, and shrimp 16.45 mg/kg, with carcinogenic high molecular weight PAHs such as benzo[a]pyrene, chrysene, benzo[b]fluoranthene, and benzo[g,h,i]perylene dominating across all matrices. The predominance of these chemicals clearly suggested pyrogenic inputs from fuel burning and industrial activity, with further contributions from petroleum waste. The health risk evaluation revealed that the hazard quotient (HQ) for numerous PAHs exceeded unity, indicating the possibility of non-carcinogenic consequences from seafood consumption. This research fills critical gaps in understanding trends and sources apportioment and it also addresses linking water and biota contamination levels with potential human risks. Comparisons with previous research in Nigeria and internationally revealed that PAH concentrations in Lagos Lagoon are much greater, indicating the cumulative influence of urbanization, petroleum activities, and inadequate waste management. This study offers baseline data on PAHs in Lagos Lagoon and advances understanding by establishing the amount of bioaccumulation in several aquatic species. The findings highlight the critical need for regulatory interventions, enhanced pollution control, and additional research into remediation solutions to maintain ecosystem integrity and human health.

Keywords: Polycyclic aromatic hydrocarbons, Lagos Lagoon, aquatic organisms, bioaccumulation, and health risk assessment

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List of Acronyms

Abbreviation	Meaning
PAH	Polycyclic Aromatic Hydrocarbon
DDT	Dichlorodiphenyltrichloroethane
DNA	Deoxyribonucleic Acid
WHO	World Health Organization
NESREA	National Environment Standard and Regulations Enforcement Agency
USEPA	United States Environmental Protection Agency
IARC	International Agency for Research on Cancer
TEF	Toxic Equivalency Factor
GLSAB	Great Lakes Science Advisory Board
NDA	Niger Delta Area
LMW	Low-Molecular Weight
HMW	High-MolecularWeight
EPA	Environmental Protection Agency
EU	European Union
LPG	Liquefied Petroleum Gas
SPM	Suspended Particulate Matter
ERL	Effects Range Low
ERM	Effects Range Median
SV	Screening Value
GCMS	Gas Chromatography-Mass Spectrometry

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NIOMR	Nigerian Institute for Oceanography and Marine Research
GC	Gas Chromatography
FID	Flame Ionization Detector
EDI	Estimated Daily Intake
THQ	The Hazard Quotient
ILCR	Incremental Lifetime Cancer Risk
FAO	Food and Agriculture Organization

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