# OCCURRENCE OF MICROPLASTICS IN SURFACE SEDIMENTS OF BEACHES IN LAGOS, NIGERIA

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This study investigated the occurrence and abundance of microplastics in surface sediments from four beaches in Lagos State, Nigeria. The beaches are Alpha, Oniru, Eleko and Lekki. Microplastics were taken from the sediments by floatation method. The number of microplastics in 50 g of dry sediment were counted with a photo microscope and results were as follows: Eleko (170 ± 21 items), Lekki (141 ± 36 items), Alpha (133 ± 16 items), and Oniru (121 ± 38 items). Fragments dominated among the microplastics found in the beaches while three polymers; polypropylene (PP), polyethylene (PE) and polystyrene (PS) were identified using Fourier transform infrared spectroscopy (FTIR). This study serves as baseline for further investigations on the occurrence of microplastics in the Nigerian coastal environment.

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## INTRODUCTION

Plastic debris is ubiquitous in all ecosystems and it presently has the attention of environmental scientists and policy makers.[1,2] They disintegrate into smaller particles in the environment and when the particles reach a size below 5 mm, they are called microplastics.

Microplastics are plastics particles less than 5 mm in any one dimension.[3,4] In most cases, they are only discernable to the eye with the use of microscopy.[5] However, most authors define microplastics as plastics particles whose longest diameter is <5 mm.[6] The presence of small plastic fragments in marine environment was first highlighted in the 1970s and renewed interest in microplastics over the past decade has shown that these contaminants are widespread and ubiquitous in the marine environment with the potential to cause harm to biota.[7-9]

Microplastics are of two types; primary and secondary microplastics. Plastics manufactured to be of microscopic size are defined as primary microplastics. Primary microplastics are used in facial-cleansers, cosmetics, personal cleansing and house-hold products.[4,10] Secondary microplastics occur when larger pieces of plastics break down into smaller pieces as a result of photochemical, mechanical and biological processes.[11,12] Microplastic sources in the environment include waste water treatment plants (WWTPs), biosolid application, storm water overflow, incidental releases such as tire wear, release from industrial products or processes, and atmospheric deposition.[3,13,14]

Microplastics accumulated in the marine environment are carriers of many pollutants which can affect the development of organisms. The risks to organisms include physiological injuries, blockage of digestive tract, alteration of feeding and reproductive activities and decreased immune response.[15-17] They sorb persistent organic pollutants such as PCBs, DDT, PAHs and organochlorine pesticides.[18-21] They have the potential to be ingested by marine biota and may be transferred to higher food chain.[7,22-25] Microplastics are like other classes of chemical contaminants such as pesticides, trace metals and flame retardants and should be handled as such rather than simply a single compound.[26]

The ubiquitous nature of microplastics and their ability to break into smaller particles even into nano levels make them a major concern for the environment. This is further heightened by the ability of these microplastics to move through the food chain.[25] Occurrence of microplastics in aquatic environment has been studied by several workers.[27-33] However, there has been paucity of data on microplastic occurrence in Africa especially West Africa. This study is the first attempt to quantify microplastics in the Nigerian coastal environment. The aim, therefore, was to quantify microplastic abundance and identify the nature of microplastics in surface sediments from four beaches along the West African coast in Lagos State, Nigeria.

## EXPERIMENTAL

### Sampling sites

**Table 1.** Sampling stations and geographical coordinates.

| Sample/Beach Designation | Beach Name | Coordinates |
|---|---|---|
| A | Alpha | N6.4225 E3.5236 |
| B | Oniru | N6.4398 E3.4306 |
| C | Eleko | N6.4403 E3.8472 |
| D | Lekki | N6.2518 E3.4432 |

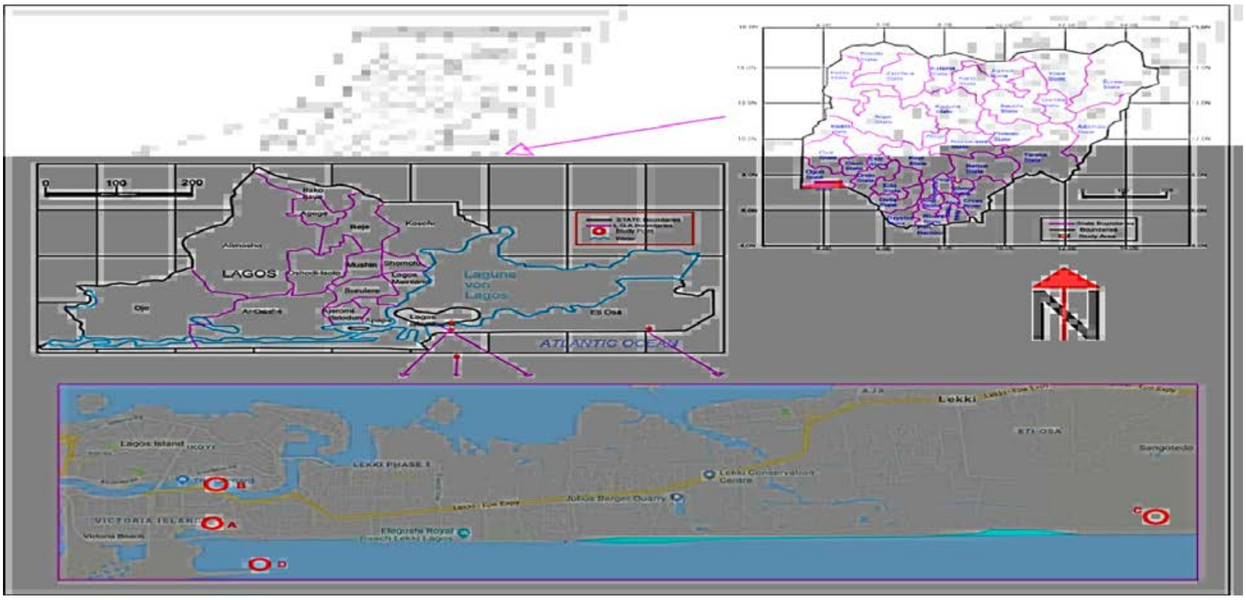


**Figure 1.** Geographical location of the study area showing the four sampling sites.

The beaches (Alpha, Oniru, Eleko and Lekki) used for this study are located in Lagos State, southwestern Nigeria. (Table1, Figure 1). They are bound by the Atlantic Ocean and serve as "fun spots" for tourists and fun seekers. Sediment samples were collected with a steel spoon along the littoral zones of each beach. Surface sediments (1-5 cm) were randomly collected with a stainless-steel spoon and a 20 × 20 cm wooden quadrant. In each beach, samples were randomly collected from three different points and thoroughly mixed to form a single composite sample. Samples were transferred to an aluminum foil, properly sealed and transported to the laboratory. Samples were collected in March 2018.

#### Sample Preparation and Processing

The sediment samples were dried at 50 °C for 48 h and sieved through a 5 mm mesh. Density floatation method was used to extract microplastics from the sediment.[30,32] Triplicate 50 g dried sediment of each sample was weighed into a glass beaker and 200 ml NaCl solution (300 g/L) was added to the samples. The mixture was stirred for two min, properly covered with aluminium foil and kept for 24 hours. The supernatant containing microplastics was then filtered with vacuum pump. The filtrate was discarded while the residue which contained microplastics was dried in the oven at 50 °C for 24 h and stored in glass Petri dishes.

#### Enumeration and identification

Materials were examined with photo microscope (Olympus CX31RTSF) equipped with Olympus E330-ADU1.2X6K1338 camera at 40x magnification. Photographs of suspected particles were directly taken on the filters. Natural debris was separated from particles suspected to be microplastics during visual inspection according to the criteria enumerated by other workers.[33-36] Selected suspected particles were further identified with FTIR (Buck Scientific M530 USA). Spectra were in transmittance mode and ranged from 500 to 4000 $cm^{-1}$. Polymer types were identified by matching the wavelength data with those obtained from literatures. Laboratory materials used for sample preparation and extraction were rinsed with double distilled water and all liquids were filtered before use. Samples were covered when not in use and filters were carefully examined to prevent contamination by air-borne particles. Blank extraction was also run without the samples to ensure non-contamination.

## RESULTS AND DISCUSSION

#### Abundance

Microplastics were found in the triplicate samples from all sampling stations (Figure 2). This implies that Nigerian beaches are not immune to microplastic pollution and accumulation.

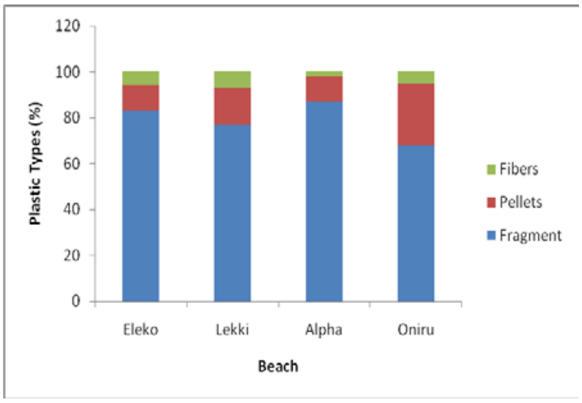


**Figure 2.** Abundance of microplastic types in the sediment samples.

Concentrations of microplastics in 50 g of dry sediment were in the following order: Eleko beach (170 ± 21 items), Lekki beach (141 ± 36 items), Alpha beach (133 ± 16 items) and Oniru (121 ± 38 items). Eleko beach had the highest number of microplastics while Oniru beach had the least number of microplastics. Oniru beach, apart from being a private beach does not allow the use of plastic materials. It is one of the beaches in Nigeria that has become conscious of the potential environmental risk of microplastics. It is usually ambiguous to ascertain the sources of microplastics in beach sediments. This is because plastics in beach sediments have long residence time and are highly fragmented under high UV irradiation, high temperature and physical abrasion by waves.[37]

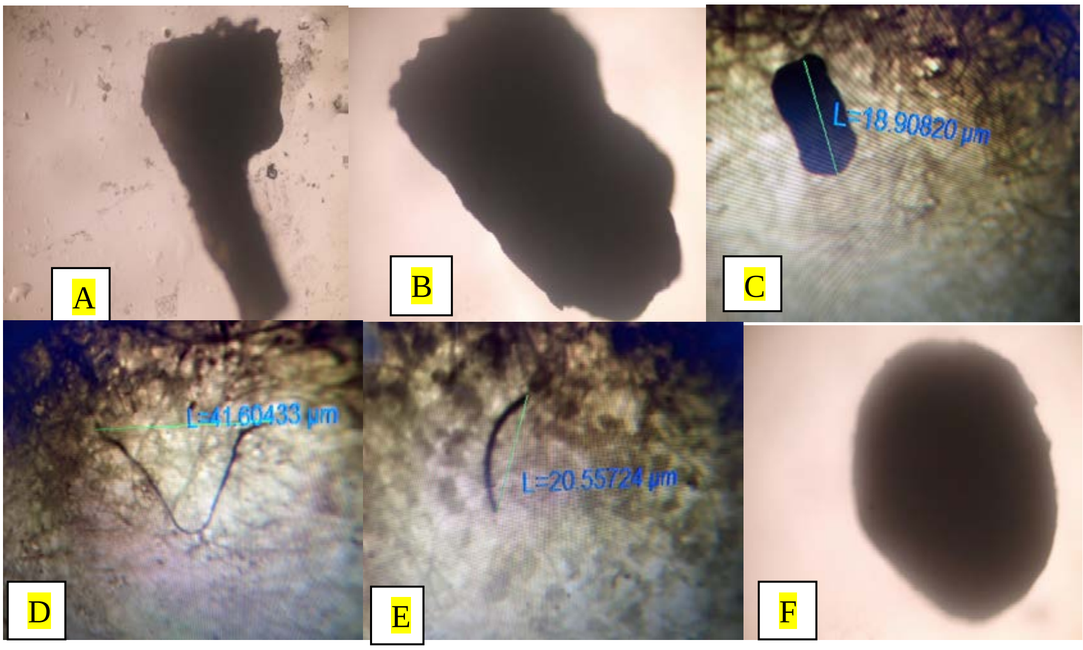


**Figure 3.** Types of Microplastics identified in the samples A-C; Fragment D-E; Fiber F; Pellet.

These microplastics may be washed ashore from the ocean[38] or may be from fragmentation of larger plastics littered on the shore as a result of photochemical, mechanical and biological processes.[11,12] No particular pattern was observed in the abundance of microplastics in the sediments except that fragments dominated in all samples followed by pellets and then fibers. (Figures 2 and 3). This similarity in the nature of microplastics from all these sites indicates the uniformity of their likely sources. The higher number of fragments suggests the breakdown of larger plastic items into secondary microplastics as the most significant source of microplastics in the beaches. It is difficult to compare microplastics abundance in different countries and regions due to different sampling and analysis protocols such as solutions used for density floatation, enumeration and identification methods, pre-treatment temperature and lack of standardized normalization units.[1,3,21,28] However, the result of this study confirms the ubiquitous nature of microplastics in the Atlantic as reported in other studies from different regions and locations.[14, 39-43] It is also possible that microplastics in these sediments were underestimated because only microplastics with density <1.2 g/cm$^3$ could be extracted with the solution used for density floatation.[35,44,45]

#### Composition

The results of FTIR analysis of some of the samples confirmed the presence of polyethylene (PP), polypropylene (PP), and polystyrene (PS) when compared with other wavelength data in literature.[28,31,46] Polystyrene was dominant among microplastics selected for FTIR analysis while the only two fibers analysed presented as polypropylene. Four pellets were found to be polyethylene. Polystyrene is used in rigid food service containers such as disposable cups and plates (popularly known as “takeaways” in Nigeria) and for building insulation. It is more susceptible to outdoor weathering than the other polymers identified in this study,[47] apparently, one of the reasons it dominates among microplastics selected for FTIR analysis; the other reason being poor management of wastes generated by eateries on these beaches. Polyethylene is commonly used in plastic wrappings and bags, drainpipes, bottles, and garbage bins while polypropylene is used in manufacturing disposable bottles, piping systems, and automotive components.[28,33,48] Polypropylene fibers are used in ropes, fishing nets and diapers.[33]

## CONCLUSION

Microplastics largely dominated by fragments were found in sediments of the four beaches used for this study. Polymers identified include polyethylene (PE), polypropylene (PP) and polystyrene (PS). The result of this study serves as baseline information on the occurrence, abundance and nature of microplastics in the Nigerian coastal environment.

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