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Biodegradation of Low-Density Polyethylene and Polyethylene Terephthalate by Bacterial and Fungal Isolates from Active Dumpsites in Ogwa and Ebelle Communities of Esan Land

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Abstract

Plastic pollution is a growing environmental challenge due to the persistent non-degradability of plastics. This study assessed the biodegradation of low-density polyethylene (LDPE) and polyethylene terephthalate (PET) by bacterial and fungal isolates from soil samples collected at active dumpsites in Ogwa and Ebelle communities. Bacterial isolates, including *Pseudomonas aeruginosa* and *Pseudomonas fluorescens*, and the fungal isolate *Aspergillus niger* were identified. These microorganisms were screened for their ability to degrade LDPE and PET, using a minimal salt medium (MSM) supplemented with 0.1% powdered plastic as the sole carbon source for 14 days. The weight loss was determined through gravimetric analysis, and chemical changes in the plastics were assessed using Fourier-transform infrared (FTIR) spectroscopy. The results revealed that *Pseudomonas aeruginosa* and *Aspergillus niger* exhibited the highest degradation potentials, with weight loss percentages of 12.9 ± 0.5% and 14.6 ± 0.5% for LDPE, and 10.5 ± 0.4% and 11.3 ± 0.4% for PET, respectively. FTIR spectra showed significant modifications in functional groups (C=O stretching at 1710 cm^{-1} and O-H stretching at 3400 cm^{-1}), indicating plastic degradation. These findings suggest that *Pseudomonas aeruginosa*, *Pseudomonas fluorescens*, and *Aspergillus niger* are promising candidates for enhancing plastic biodegradation, contributing to the development of sustainable environmental management strategies.

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Introduction

Plastic pollution has turned out to be one of the most widespread environmental problem in the 21st century mostly due to overproduction of synthetic polymers globally and insufficient waste management facilities (Heris, 2024). Over 400 million metric tons of plastic are manufactured yearly all over the world, with much of it pertaining to single-use and thereafter disposed (Plastics Europe, 2023). Also, about 8 million metric tons of plastic waste are released by the land-based sources annually into the oceans, with the developing nations been especially impacted since indiscriminate disposal is a common phenomenon (Jambeck *et al*., 2015; Enerijiofi and Ekhaise, 2022). Such dumping makes it the ideal locations of environmental poisoning where microplastics and chemical additives leach into the soil, rivers, air, and even human blood, which makes people concerned about possible toxicological impact of microplastics and nanoplastics (Barrett *et al*., 2022; Nath *et al.,* 2024; Sharma *et al*., 2021). According to FAO, 33% of Earth's soil is already ruined and over 90% could be tainted by 2050 (Weeratna, 2022). The need for a healthy soil environment cannot be over-emphasized if 76.47% of the total sustainable development goals (SDGs) will be attained by 2030 because they are all related to healthy living for man and the environment (Enerijiofi *et al*., 2025).

Traditional approaches to the management of plastic wastes like burning, landfilling and recycling are unsustainable as incineration releases greenhouse gases, while landfilling consumes land areas and could lead to leachates production and groundwater pollution (Amobonye *et al*., 2021; Borchardt *et al*., 2023). There is therefore a shift of interest to a sustainable alternative which involves biologically-based solutions, especially microbial breakdown of plastics in a natural or controlled setting (Enerijiofi

and Ekhaise, 2022; Srikanth *et al*., 2022). Microorganisms found in the landfills and dumpsites have the ability to lower the weight of the polyethylene films and alter their surface structure which is a sign of partial degradation (Muhonja *et al*., 2018). The biodegradation of plastic usually occurs in four steps; bio-deterioration, depolymerization, assimilation, and mineralization (Heris, 2024; Shilpa *et al*., 2022).
Bacillus cereus and *Brevibacillus borstelensis* were able to degrade low-density polyethylene (LDPE) and their biodegradability depend on enzyme systems that can help break the carbon-carbon bonds found in plastics (Mandal *et al*., 2024). It is also important to note that one of the bacteria that metabolize PET to form its constituents and fully assimilate branched polycentricity is *Ideonella sakaiensis*, which has been found in PET-contaminated sediment and possesses PETase and MHETase enzymes enabling the degradation of PET into its building blocks (Yoshida *et al*., 2016; Heris, 2024). Fungi' large hypha networks and capacity to produce a combination of a variety of oxidative enzymes give them a structural and biochemical edge. The lignin-degrading enzyme systems, laccase, lignin peroxidase (LiP), and manganese peroxidase (MnP), which are the most popular in degrading synthetic polymers, are found in white-rot fungi, like *Phanerochaete chrysosporium* and *Pleurotus ostreatus* (Srikanth *et al*., 2022). Low-density polyethylene, Poly vinyl chloride and polyurethane have also been reported to be degraded by other types of fungi including *Aspergillus niger, Penicillium chrysogenum* and *Bjerkandera adusta* (Mandal *et al*., 2024). Among the most impressive fungi is *Pestalotiopsis microspora* that can break down polyurethane even under anaerobic conditions, hence it is the most appropriate in the landfill scenario (Russell *et al*., 2011). Several large-scale studies of microbial plastic degradation have been performed mainly in areas like Asia and Europe with little or no such studies in dumpsites located in Africa where plastic pollution has assumed a hydra headed ecological challenge. The aim of this study was to biodegrade low-density polyethylene and polyethylene terephthalate using indigenous bacterial and fungal isolates from active dumpsites in Ogwa and Ebelle Communities of Esanland

Materials and Methods

Study Area: Ogwa and Ebelle towns located in Esan West and Igueben Local Government Areas respectively of Edo State, Nigeria. They are independent communities in Esan land with Ogwa playing host to Glorious Vision University. The research work was carried out in Biological Sciences Laboratory of Glorious Vision University, Ogwa, Edo state, Nigeria

Collection of Samples: A total of fifteen (15) soil samples were collected for the research work from different active dumpsites locations within the Ogwa and Ebelle communities containing visibly plastic-contaminated waste in selected locations. The sites were chosen based on plastic waste density, environmental exposure, and accessibility. Using sterile Auger, composite samples were taken from the top soil, 10 – 15 cm near visible plastic debris; low-density polyethylene (LDPE) and polyethylene terephthalate (PET). Approximately 2 kg of soil per site was collected into sterile, labelled plastic containers and transported to the laboratory under ambient conditions for microbiological analysis.

Types of Plastic Used For Biodegradation: Commercial low-density polyethylene (LDPE) and polyethylene terephthalate (PET) were selected for biodegradation assays. LDPE was sourced from clean, transparent shopping bags, while PET was obtained from soft drink bottles. The plastics were cut into uniform strips (2 × 2 cm), washed with 70% ethanol, rinsed with distilled water, and air-dried. Pre-weighed samples were stored in sterile conditions until further use. All plastic samples were subjected to UV pre-treatment for 48 hours and thermal oxidation at 60°C for 2 hours to improve microbial adhesion, before biodegradation experiments.

Isolation of Bacterial and Fungal isolates from the Samples: One gram of homogenized soil samples water added to 9mls sterile distilled water to obtain a stock. The stock was thoroughly mixed and serially diluted to tenfold. Appropriate 0.1ml aliquots of soil sample dilution from 10^{-3}, $10^{-6}$and 10^{-9} was plated on Nutrient agar plates in triplicates containing fucshin and Potato Dextrose agar plates containing two drops of streptomycin for the determination of bacterial and fungal growth. The plates were incubated at 37°C for 24 hours and at room temperature for 72 hours for bacterial and fungal enumeration respectively. To obtain pure culture, the presumed colony of isolates from each plate was subsequently sub-cultured on Nutrient agar and potato dextrose agar for bacterial and fungal respectively (Enerijiofi and Ekhaise, 2019).

Identification and Characterization of Bacterial Isolates

The preserved bacterial isolates were identified using conventional morphological and phenotypic characteristics. They were thereafter subjected to starch hydrolysis according to Buchaman and Gibbons, (1974) and casein hydrolysis and gelatin

hydrolysis (Hemraj *et al.,* 2013). The un-inoculated sample served as control. Selected fungi colonies of different morphological characteristics were picked, numbered and sub-cultured individually by streaking on fresh solidified potato dextrose media until pure cultures were obtained (Holt *et al*., 1994). They were preserved for further analysis.

Screening For Plastic-Degrading Potential

Clear Zone Method (for qualitative screening): Isolates were screened on Minimal Salt Medium (MSM) supplemented with 0.1% powdered LDPE or PET as the sole carbon source. Plates were incubated for 14 days, and zones of clearance were observed around colonies, indicating plastic degradation.

Solid-State Biodegradation Setup: Isolates that exhibited positive results during the primary screening phase were selected for detailed plastic degradation experiments. Each selected isolate was inoculated into a 250 mL Erlenmeyer flask containing 100 mL of sterile Minimal Salt Medium (MSM) and one piece of pre-weighed low-density polyethylene (LDPE) or polyethylene terephthalate (PET) strip. The MSM used had the following composition per liter: 1.0 g KH_2PO_4, 1.0 g $NaHPO_4$, 1.0 g NH_4NO_3, 0.2 g $MgSO_4 \cdot 7H_2O$, 0.1 g NaCl, and 0.5 g yeast extract (included only for bacterial cultures), with the pH adjusted to 7.0. The flasks were incubated for up to 30 days at 30°C for bacterial isolates and 28°C for fungal isolates, under continuous shaking at 120 rpm to ensure aeration and nutrient distribution. Uninoculated flasks containing the same setup but without microbial cultures served as negative control.

Assessment of Plastic Degradation

Gravimetric Weight Loss Analysis: This method was carried out to determine the weight loss after subjecting the plastics to incubation by the bacterial and fungal isolates. At the end of 30days of incubation, the plastic strips were removed from cultures, washed with 2% SDS to remove biofilm, rinsed with distilled water, dried at 60°C for 24 hours, and re-weighed.

The weight loss (%) was calculated using the formula:

$$\% \text{ Weight loss} = [(W_0 - W_1)/W_0] \times 100$$

Where:

W_0 = initial weight of plastic

W_1 = final weight after degradation

Fourier Transform Infrared Spectroscopy (FTIR): FTIR analysis was conducted on plastic samples before and after degradation to detect changes in chemical functional groups. Shifts or appearance of peaks corresponding to carbonyl, hydroxyl, or ether bonds were recorded (Thakur *et al.*, 2025)

Statistical Analysis: All experiments were performed in triplicates. Data were analyzed using SPSS software. The results were expressed as mean ± standard deviation.

Results: Ten bacterial and ten fungal isolates were successfully obtained from soil samples on plastic contaminated dump sites in Ogwa and Ebelle communities. Table 1 indicates that there was a great divergence in the colonial morphologies and pigmentation of the bacterial isolates that showed a variation in the isolates. These morphological variations gave the first basis of the identification of bacteria. Table 2 documents the existence of various species such as *Escherichia coli, Bacillus subtilis* and *Klebsiella pneumoniae*. Some of the isolates are lactose fermenters and others were non-fermenters as resulting from their metabolic diversity. This table is thus a good evidence in supporting species differentiation in terms of biochemical properties. Table 3 shows the morphology and appearance of the colonies, surface texture, and pigmentation of the fungal isolates were different on the culture media. Under microscopic examination, distinctive spore formations were also observed in *Aspergillus, Penicillium* and *Rhizopus* genera. The differences in colour and rate of growth show that the nutrient use in species is different. Therefore, the table indicates the variation and flexibility of fungi in the sampled habitat. Table 4 indicates that both *Pseudomonas aeruginosa* had the largest clear zone diameters in LDPE (11.4 ± 0.5mm) and PET (9.6 ± 0.4mm), which means that they are strong degraders that are highly active in degrading the polymer. Other isolates including *Bacillus subtilis* and *Enterobacter cloacae* demonstrated a medium degradation potential. The difference in areas of degradation implies the variability of the enzymatic abilities of the isolates. This finding proves that some bacteria have greater plastic-degrading abilities. Table 5 demonstrates that *Aspergillus niger* (12.8 ± 0.4 and 9.5 ± 0.3), *A. flavus* (11.6 ± 0.5 and 8.9 ± 0.4 mm), and *A. fumigatus* (10.4 ±0.4 mm and 8.2 ± 0.3mm) had the highest number of clear zones on the LDPE and PET film respectively. These findings demonstrate that these species release strong extracellular enzymes that degrade polymers. Other isolates such as *Rhizopus* and *Penicillium* were moderately active. The data therefore confirm the good biodegradation capabilities of *Aspergillus* species over others. Table 6 indicates that *Pseudomonas aeruginosa*, in both LDPE (12.9 ± 0.5%) and PET (10.5± 0.4%) had the highest

percentage weight loss after 30 days of incubation. This was succeeded by *Pseudomonas fluorescens* 11.8 ± 0.4% and 9.6 ± 0.3% for LDPE and PET respectively and *Bacillus subtilis* with a moderately lesser degradation rate. The findings show that there is a great variation in the capacity of bacterial isolates to decompose synthetic polymers. Therefore, this validates *P. aeruginosa* as the most effective bacterial degrader among the isolates. The results of Table 7 demonstrate that *Aspergillus niger* gave the highest weight reduction in both LDPE and PET at 30 days (14.6± 0.5% and 11.3± 0.4% respectively) compared to other fungi isolates. The degradation activity of *A. flavus* and *A. fumigatus* was also strong with moderate effects by *Penicillium* and *Rhizopus.* These differences are indicative of the different enzymatic abilities and the adjustment to polymer substrates. In all, the table highlights the high-level degradative ability of *Aspergillus* species. FTIR spectra of LDPE and PET films revealed distinct modifications in functional groups with prominent peaks around 1710 cm^{-1} (C=O stretching) and 3400 cm^{-1} (O–H stretching) after bacterial and fungal treatments, indicating oxidation and chain scission. However, the most significant spectral changes were observed in plastics degraded by *P. aeruginosa*, *B. subtilis*, *A. niger*, and *A. flavus*.

Table 1: Morphological Characteristics of Bacterial Isolates

Isolate Code	Colony Colour	Elevation	Margin	Texture	Gram Reaction	Shape
B1	Cream	Raised	Entire	Smooth	+	Rod
B2	Yellow	Flat	Undulate	Smooth	+	Cocci
B3	Off-white	Convex	Entire	Mucoid	–	Rod
B4	Pale yellow	Raised	Entire	Dry	–	Rod
B5	White	Flat	Irregular	Rough	+	Rod
B6	Greenish	Convex	Entire	Smooth	–	Rod
B7	Cream	Flat	Entire	Smooth	–	Rod
B8	Yellowish	Convex	Undulate	Smooth	+	Cocci
B9	Pinkish	Raised	Entire	Mucoid	–	Rod
B10	Cream	Flat	Entire	Smooth	–	Rod

Table 2: Biochemical Characterization and Tentative Identification of Bacterial Isolates

Test/Isolate	Indole	MR	VP	Citrate	Nitrate	Catalase	Oxidase	Sugar Fermentation	Probable Organism
B1	+	+	–	–	+	+	–	Glu(+), Lac(+)	*Escherichia coli*
B2	–	–	+	+	+	+	+	Glu(+), Suc(+)	*Bacillus subtilis*
B3	–	–	+	+	+	+	+	Glu(+), Suc(+), Lac(–)	*Klebsiella pneumoniae*
B4	+	+	–	–	+	+	–	Glu(+), Man(+)	*Proteus mirabilis*
B5	–	–	+	+	+	+	+	Glu(+), Suc(+), Raf(+)	*Pseudomonas aeruginosa*
B6	–	+	–	–	+	+	–	Glu(+), Man(+)	*Micrococcus luteus*
B7	+	+	–	–	+	+	–	Glu(+), Lac(+)	*Enterobacter cloacae*
B8	–	–	+	+	+	+	–	Glu(+), Man(+)	*Staphylococcus aureus*
B9	–	+	–	–	+	+	+	Glu(+), Raf(+)	*Pseudomonas fluorescens*
B10	–	+	–	+	+	+	–	Glu(+), Suc(+)	*Bacillus cereus*

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Table 3: Cultural and Microscopic Features of Fungal Isolates

Isolate Code	Colony Colour	Surface Texture	Reverse Colour	Microscopic Observation	Probable Identity
F1	Black	Woolly	Yellow	Septate hyphae, conidial heads	*Aspergillus niger*
F2	Green	Velvety	Pale yellow	Radiate conidial heads	*Aspergillus flavus*
F3	White	Cottony	Cream	Sporangia on sporangiophores	*Rhizopus stolonifer*
F4	Grayish white	Fluffy	Pale gray	Branched conidiophores	*Penicillium chrysogenum*
F5	Brownish	Rough	Light brown	Dark septate hyphae	*Alternaria alternata*
F6	Black	Velvety	Black	Ovoid conidia	*Aspergillus fumigatus*
F7	Cream	Cottony	Yellow	Chlamydospores present	*Fusarium oxysporum*
F8	White	Powdery	Colourless	Spherical sporangia	*Mucor racemosus*
F9	Dark green	Velvety	Yellowish	Dense conidial structure	*Trichoderma harzianum*
F10	Pinkish	Fluffy	Pale pink	Septate hyphae, macroconidia	*Curvularia lunata*

Table 4: Qualitative Screening of Plastic-Degrading Bacteria (Clear Zone Diameter after 14 days)

Isolate	LDPE (mm)	PET (mm)	Degradation Activity
B1 (*E. coli*)	7.2 ± 0.3	4.1 ± 0.2	Moderate
B2 (*B. subtilis*)	9.8 ± 0.4	6.5 ± 0.3	Strong
B3 (*K. pneumoniae*)	6.7 ± 0.5	5.3 ± 0.3	Moderate
B4 (*P. mirabilis*)	4.9 ± 0.2	3.0 ± 0.2	Weak
B5 (*P. aeruginosa*)	11.4 ± 0.5	9.6 ± 0.4	Strong
B6 (*M. luteus*)	3.5 ± 0.3	2.8 ± 0.2	Weak
B7 (*E. cloacae*)	7.0 ± 0.4	5.0 ± 0.3	Moderate
B8 (*S. aureus*)	2.9 ± 0.1	2.0 ± 0.2	Weak
B9 (*P. fluorescens*)	10.6 ± 0.5	8.3 ± 0.4	Strong
B10 (*B. cereus*)	8.1 ± 0.4	5.9 ± 0.3	Moderate

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Table 5: Qualitative Screening of Plastic-Degrading Fungi (Clear Zone Diameter after 14 days)

Isolate	LDPE (mm)	PET (mm)	Degradation Activity
F1 (*A. niger*)	12.8 ± 0.4	9.5 ± 0.3	Strong
F2 (*A. flavus*)	11.6 ± 0.5	8.9 ± 0.4	Strong
F3 (*R. stolonifer*)	6.5 ± 0.3	4.3 ± 0.2	Moderate
F4 (*P. chrysogenum*)	8.7 ± 0.3	6.8 ± 0.2	Moderate
F5 (*A. alternata*)	4.5 ± 0.2	2.9 ± 0.1	Weak
F6 (*A. fumigatus*)	10.4 ± 0.4	8.2 ± 0.3	Strong
F7 (*F. oxysporum*)	5.3 ± 0.2	3.8 ± 0.2	Weak
F8 (*M. racemosus*)	3.4 ± 0.3	2.5 ± 0.2	Weak
F9 (*T. harzianum*)	9.5 ± 0.3	7.1 ± 0.3	Moderate
F10 (*C. lunata*)	4.0 ± 0.2	3.0 ± 0.2	Weak

Table 6: Weight Loss of LDPE and PET Films by Bacterial Isolates after 30 Days

Isolate	LDPE (%)	PET (%)
B1 (*E. coli*)	7.8 ± 0.4	5.1 ± 0.3
B2 (*B. subtilis*)	10.2 ± 0.5	7.4 ± 0.3
B3 (*K. pneumoniae*)	8.3 ± 0.3	6.2 ± 0.2
B4 (*P. mirabilis*)	5.6 ± 0.2	4.3 ± 0.2
B5 (*P. aeruginosa*)	12.9 ± 0.5	10.5 ± 0.4
B7 (*E. cloacae*)	8.0 ± 0.3	6.0 ± 0.2
B9 (*P. fluorescens*)	11.8 ± 0.4	9.6 ± 0.3
B10 (*B. cereus*)	9.5± 0.5	8.4± 0.3

Table 7: Weight Loss (mm) of LDPE and PET Films by Fungal Isolates after 30 Days

Isolate	LDPE (%)	PET (%)
F1 (*A. niger*)	14.6 ± 0.5	11.3 ± 0.4
F2 (*A. flavus*)	13.8 ± 0.4	10.5 ± 0.3
F3 (*R. stolonifer*)	8.1 ± 0.3	6.2 ± 0.3
F4 (*P. chrysogenum*)	9.3 ± 0.4	7.0 ± 0.3
F5 (*A. alternata*)	6.2 ± 0.2	4.8 ± 0.2
F6 (*A. fumigatus*)	12.4 ± 0.4	9.8 ± 0.3
F9 (*T. harzianum*)	10.5 ± 0.3	8.2 ± 0.3
F10(*C. lunata*)	6.8± 0.2	5.4± 0.3

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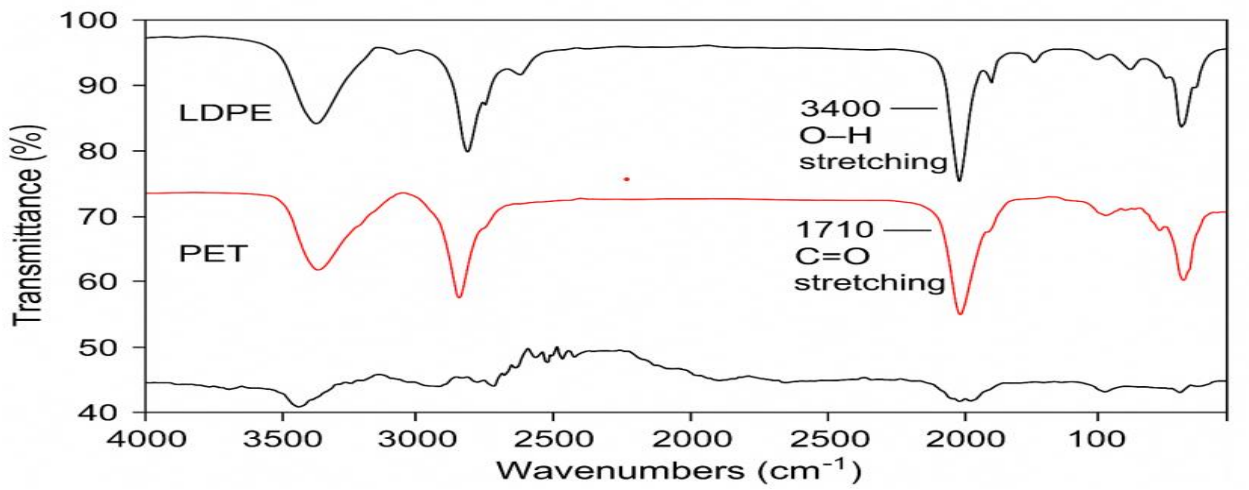

Figure 1: Fourier Transform Infrared Spectroscopy (FTIR) Analysis of the LDPE and PET

Discussion

The findings of the research on the morphological, biochemical, and degradation properties of bacterial and fungal isolates in relation to plastic degradation indicated a broad range of the ability of microorganisms to alter polymeric materials, i.e. LDPE and PET. The isolates of the bacteria also represented diverse colony morphologies such as cream, yellow, and greenish to pinkish colours with different elevations and textures according to metabolic and environmental adaptability of the bacterial isolates. Among the degraders, Gram-positive rods like *Bacillus subtilis* and *Bacillus cereus* prevailed as well as Gram-negative rods like *Pseudomonas aeruginosa* and *Pseudomonas fluorescens* exhibited high biodegradation potential. This heterogeneity can be similar to the results of Chattopadhyay (2022) and Thakur *et al.,* (2025) who underlined the importance of microbial biofilms and enzymatic systems regarding plastic degradation as the effect of oxidative and hydrolytic processes supported by microbial communities in different environments.

The biochemical characterization also favoured the identification of strong degraders including *P. aeruginosa, B. subtilis, E. coli* and *K. pneumoniae* which were positive to various enzymes such as catalase and oxidase, which is a sign of high oxidative metabolism. These enzymes play a critical role in stimulating the scission of polymer chains by hydrogen bonds in the structure of plastic items by cleaving carbon bonds, as documented by Behera and Das (2023) who pointed out the ability of plastisphere microbes to convert microplastics by enzymatic oxidation and further mineralization. The greater efficiency of the isolates like *P. aeruginosa* and *B. subtilis* in degrading LDPE and PET compared to other isolates highlights the metabolic versatility and plasticity of these isolates, which is also in line with the microbial division of labour concept as outlined by Bao *et al*. (2023), where synergies on the breakdown of polymers are more effective when these isolates are combined.

Through the qualitative screening it was found that bacterial isolates such as *P. aeruginosa, P. fluorescens* and *B. subtilis* formed the biggest clear colonies on the LDPE and PET films which indicated a high degradation ability. *Aspergillus niger, A. flavus*, and *A. fumigatus* were found to have superior hydrolytic activity, which means that they formed bigger clear rings than *Rhizopus stolonifer* and *Penicillium chrysogenum*. This observation is consistent with Xu and Bai (2022) who described that under most cases, fungi tend to be better at degradation because of their extracellular enzyme systems and capability to penetrate hypha which increase contact with the surface and oxidation of polymers. The degradation capacity of the fungal isolates used in this research is high which would verify that the filamentous fungi are still important players in the process of polymer degradation as has been confirmed by Liu *et al*. (2024) and Nath *et al*. (2024) who reported that fungal enzymatic systems are effective in reducing the size and mass of microplastics in aqueous conditions.

P. aeruginosa recorded the best weight loss in LDPE (12.9%) and PET (10.5%) followed by *P. fluorescens* and *B. subtilis* under quantitative assessment. On the same note, *A. niger* (14.6% LDPE, 11.3% PET) and *A. flavus* (13.8% LDPE, 10.5% PET) had the greatest weight loss of fungi. The highest weight reduction in the aforementioned isolates could be due majorly to

the extracellular enzymes such as laccases, esterases and cutinases which they secrete. The identified isolates are similar to the reports of Muhonja *et al.* (2018) where *Pseudomonas, Micrococcus, Acinetobacter* where isolated from Nairobi and used in degradation of LDPE. Also, Guo *et al*. (2024) posited that enzymatic microbial pathways specifically those involved in the production of oxidative and hydrolytic enzymes are one of the major innovations in the chemical conversion of polymer waste. The identified weight loss patterns are also associated with the results of Maity *et al* (2021) who characterized microbial degradation as a multi-step process comprising adsorption, depolymerization, and mineralization with the help of active surface enzymes.

The FTIR result showed that the functional groups of LDPE and PET films changed distinctly after the treatment by microbes. Those developing as new absorption peaks were 1710 cm-1 (C=O stretching) and 3400 cm-1 (O-H stretching) which showed oxidative degradation and polymer chain scission. These spectral changes are observations that support the fact that oxygen containing groups like alcohol and or carboxyl have been successfully incorporated into the polymer backbone by the microbial enzymes, which is a characteristic of biodegradation. However, bacterial adhesion and biofilm formation on hydrophobic surfaces of the LDPE is important for the degradation of polymer by bacterial isolates (Thakur *et al.,* 2025). Also, in corroboration, equivalent FTIR variations were described by Shi *et al*. (2021) who indicated that oxidation and hydroxylation are major signs of structural deterioration in plastics treated with microbes or other environmental conditions. Their high biodegradation potential is supported by the great spectral differences in the samples subjected to *P. aeruginosa, B. subtilis, A. niger*, and *A. flavus*, which are consistent with the results reported by Nizzetto *et al*. (2016), who emphasized that microorganisms play an important part in the oxidation of polymers in soil systems.

The fungal isolates displayed higher percentage loss than the bacterial isolates. This is in line with Jambeck *et al*. (2015) who have highlighted that the efficiency of microbial degradation differs among taxonomic groups because of variation in the expression of enzymes and affinities to substrates. Such good performance of fungi may be explained by their ample hypral networks and through their secretion of strong extracellular enzymes that can break down complex polymers as earlier reported (Ikhajiagbe *et al*., 2021). Moreover, Van Oosterhout *et al*. (2023) recommended that the rising environmental footprint of plastic waste requires the exploitation of the biological degradation routes as the sustainable ways of plastic waste management with the focus on the ecological significance of the involvement of microbial interventions.

Conclusion and Recommendation

Pseudomonas aeruginosa, Bacillus subtilis and *Aspergillus niger* were the most effective degraders of low-density polyethylene (LDPE) and polyethylene terephthalate. This was because they displayed a clearer zone formation and loss of mass, which were due to their elaborate hyphae structures and release of stronger extra-cellular enzymes. The decomposition of polymer was also ascertained using the FTIR analysis through the formation of new functional groups, a testament that plastic structure is an oxidative-hydrolyte structure. The identified bacterial and fungal isolates possess enormous potential of degrading plastics. However, there is need to improve adaptation of these microorganisms to degrade plastics in complex environment, engineer the high efficiency enzymes and optimize the microbial communities for real-world bioremediation of plastics polluted environment to ensure environmental sustainability.

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