



Assessment of the Plastic Degradation Potential of Two Microorganisms Isolated from Natural Polymers

Adebisi Esther Enochoghene^{1,2*}, Godswill Ehimengbale Akhigbe³, Oluwoleola Henry Ogunkoya¹ & Adonis Oghenekaro Aruoture¹

¹Department of Biological Sciences, McPherson University, 110117, Seriki Sotayo, Ogun State, Nigeria

²Department of Sustainability Studies, University of Ibadan, 200005, Ibadan, Nigeria.

³Department of Chemical Sciences, McPherson University, 110117, Seriki Sotayo, Ogun State, Nigeria

Received 3 March 2026; Revised 6 October 2026; Accepted 17 October 2026

Published 30 October 2026

DOI: 10.24191/bioenv.v4i3.143

ABSTRACT. This study evaluated the potential of two bacterial isolates obtained from pawpaw latex and cashew gum to promote the deterioration of low-density polyethylene (LDPE). Bacteria were isolated on nutrient agar and incubated with preweighed LDPE films (approximately 0.100 g) in mineral salts medium for 54 days. Changes in film mass, surface morphology and elemental composition were assessed using gravimetric analysis, scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDX), respectively. The isolates showed their closest reported 16S ribosomal RNA gene sequence matches to *Enterobacter* and *Alcaligenes* reference sequences. Films incubated with the pawpaw-latex isolate and cashew-gum isolate exhibited mass losses of 33.91% and 24.79%, respectively. SEM revealed surface folds, cracks and pores, while EDX indicated differences in surface elemental composition between treated and control films. These observations suggest LDPE-associated mass loss and surface deterioration under the experimental conditions. However, the absence of independent replication, the presence of glucose in the medium and the semiquantitative nature of EDX limit attribution of these changes to bacterial degradation of the polymer. The findings therefore provide preliminary evidence of LDPE deterioration but do not establish polymer mineralisation. Replicated experiments with appropriate carbon-source controls and analyses of polymer-chain changes, degradation products and mineralisation are required to confirm biodegradation and assess potential applications.

Keywords: Biodegradation, Low-density polyethylene, Bacterial isolates, Natural polymers, Plastic waste

1. INTRODUCTION

Degradation changes the physical or chemical state of a material (Fotopoulou & Karapanagioti, 2017). Waste-management practices include open dumping, burning, and landfilling, which can have adverse environmental consequences (Babayemi & Dauda, 2009; Salami et al., 2019; Ongia et al., 2021). Municipal waste contains materials such as glass, metals, plastics, food residues, and paper (Oyebode, 2013). Plastics constitute an important component of municipal and industrial waste because they are inexpensive, lightweight, durable, and convenient (Raziyafathima et al., 2016; Kotova et al., 2021). Petroleum-derived plastics are widely used in packaging, medical supplies, and everyday products (Kale et al., 2015; Klemeš et al., 2020; Ammendolia et al., 2021). Their extensive use contributes to plastic-waste accumulation in landfills and terrestrial and aquatic environments (Vennila et al., 2014; Kantharajan et al., 2018; Olanrewaju & Oyebade, 2019; Embrandiri et al., 2022).

*Corresponding author:

E-mail address: ae.enochoghene@ui.edu.ng (Enochoghene)

Approaches to plastic degradation include photodegradation, oxidative degradation, and biodegradation (Shawaphun et al., 2010; Gewert et al., 2015; Abdelmoez et al., 2021). Photodegradation is initiated by light exposure (Shawaphun et al., 2010), whereas oxidative degradation may be promoted by heat and light (Liu et al., 2014). Biodegradation involves biological agents, particularly microorganisms (Bremer, 2022). Polyethylene persists in the environment, although microorganisms may contribute to its deterioration under suitable conditions (Mohan et al., 2020; Samanta et al., 2020; Pathak & Navneet, 2017; Montazer et al., 2020). Microorganisms associated with polymeric substrates have therefore attracted attention as potential agents of plastic transformation (Kotova et al., 2021; Venkatesan et al., 2022). Natural polymers are macromolecules of biological origin, and their associated microorganisms may possess enzymes relevant to polymer degradation (Rajeswari et al., 2017). Polyethylene (PE) is a widely used commodity plastic (Meran et al., 2008). Accordingly, this study aimed to assess the potential of two bacterial isolates obtained from pawpaw latex and cashew gum to degrade low-density polyethylene (LDPE).

2. METHODOLOGY

2.1. Preparation of LDPE films

Food-grade low-density polyethylene (LDPE) freezer bags (Solaab, Lagos, Nigeria), with a reported thickness of 180 μm (0.18 mm), were cut into 3×3 cm pieces. The target mass was 0.1000 g per specimen; the actual initial mass of each specimen was recorded and used in subsequent calculations. The films were sterilized in 70% ethanol for 3 h and oven-dried at 50 °C for 4 h (Akhigbe et al., 2023).

2.2. Screening for Bacteria Associated with Natural Polymers

Cashew gum and pawpaw latex were collected from their respective trees under sterile conditions. For each natural-polymer source, a 1 g sample was mixed with 10 mL of sterile deionized water. Mineral salts medium (MSM; 100 mL) was prepared in conical flasks using the reported formulation of 1 g K_2HPO_4 , 1 g KH_2PO_4 , 1 g NH_4NO_3 , 0.02 g CaCl_2 , 0.05 g FeCl_3 , 0.2 g MgSO_4 , and 1 g/L glucose (Torimiro et al., 2020). Each flask received 1 mL of the polymer suspension and 0.1 g of LDPE. The flasks were incubated with shaking for 7 days to assess microbial growth. Subsequently, 0.1 mL of each culture was spread on sterile nutrient agar and incubated at 37 °C for 24 h. Individual colonies were subcultured to obtain pure cultures for subsequent biodegradation assays.

2.3. LDPE Biodegradation

Sterile MSM (100 mL), a preweighed sterile LDPE film, and a standard inoculum of an individual bacterial isolate were added to each conical flask. Control flasks contained MSM and sterile preweighed LDPE film without bacterial inoculation. All flasks were incubated with shaking at 30 °C and 120 rpm. Culture growth was monitored at 5-day intervals by measuring absorbance at 620 nm using a UV–visible spectrophotometer. LDPE film mass was also measured at 5-day intervals under sterile conditions using an analytical balance. After 54 days, the films were recovered, rinsed with deionized water, immersed in 2% sodium dodecyl sulfate (SDS) solution for 1 h to remove adherent material, and oven-dried at 50 °C for 4 h. The recovered films were subjected to gravimetric and surface analyses.

2.4 Gravimetric Analysis of LDPE Films

The percentage mass loss of LDPE films after 54 days was calculated from the initial and final film masses (Akhigbe et al., 2023):

$$\text{Mass loss (\%)} = [(\text{initial mass} - \text{final mass}) / \text{initial mass}] \times 100$$

The same films were weighed repeatedly under sterile conditions.

2.5. SEM and EDX analyses of LDPE films

After 54 days, the untreated control LDPE films and the films exposed to the selected bacterial isolates from each natural-polymer source were cut into smaller pieces and gold-coated for microscopy. Surface morphology and elemental composition were examined using a field-emission scanning electron microscope (JEOL JSM-7600F, Japan) equipped with an energy-dispersive X-ray (EDX) detector at an accelerating voltage of 20 kV (Oluwole et al., 2022).

2.6. Identification of bacterial isolates by 16S rRNA gene sequencing

Bacterial isolates from cashew gum and pawpaw latex that exhibited the highest observed LDPE-associated mass loss were cultured overnight in nutrient broth. The cultures were centrifuged at 4,722 rpm for 5 min, and the pellets were washed with phosphate-buffered saline before DNA extraction. Genomic DNA was extracted using the ZymoBIOMICS™ DNA MiniPrep kit (Onajobi et al., 2020). The 16S rRNA gene was amplified by polymerase chain reaction (PCR) using the universal primers 27F (AGAGTTTGATCMTGGCTCAG) and 1525R (AAGGAGGTGWTCCARCCGCA), following the PCR procedure reported by Akhigbe et al. (2023). The amplicons were purified by ethanol/EDTA precipitation and sequenced using an ABI PRISM 3500 genetic analyzer. Sequence data were examined in BioEdit and compared with GenBank sequences using the National Center for Biotechnology Information Basic Local Alignment Search Tool (BLAST).

3. RESULTS AND DISCUSSION

3.1. Gravimetric Analysis of LDPE Films

The percentage mass losses of LDPE films during and after the incubation period are presented in Figure 1. Films incubated with bacterial isolates WB6 and ADA1 exhibited mass losses of 33.91% and 24.79%, respectively, after 54 days. These observations suggest changes in film mass during incubation, although mass loss alone does not establish polymer biodegradation.

The observed LDPE film mass losses ranged from 3.16% to 33.91%. Previous studies reported mass losses of approximately 10% (Montazer et al., 2020), 10.15% (Samanta et al., 2020), and 1.75–11% (Ru et al., 2020) in microbial treatments of LDPE. Other investigations reported losses of 30–36% (Kale et al., 2015) and 4.9–5.2% (Abraham et al., 2017). Differences in incubation conditions, polymer composition, pretreatment, and film-cleaning procedures limit direct comparisons between studies. The present measurements were unreplicated and should therefore be regarded as preliminary.

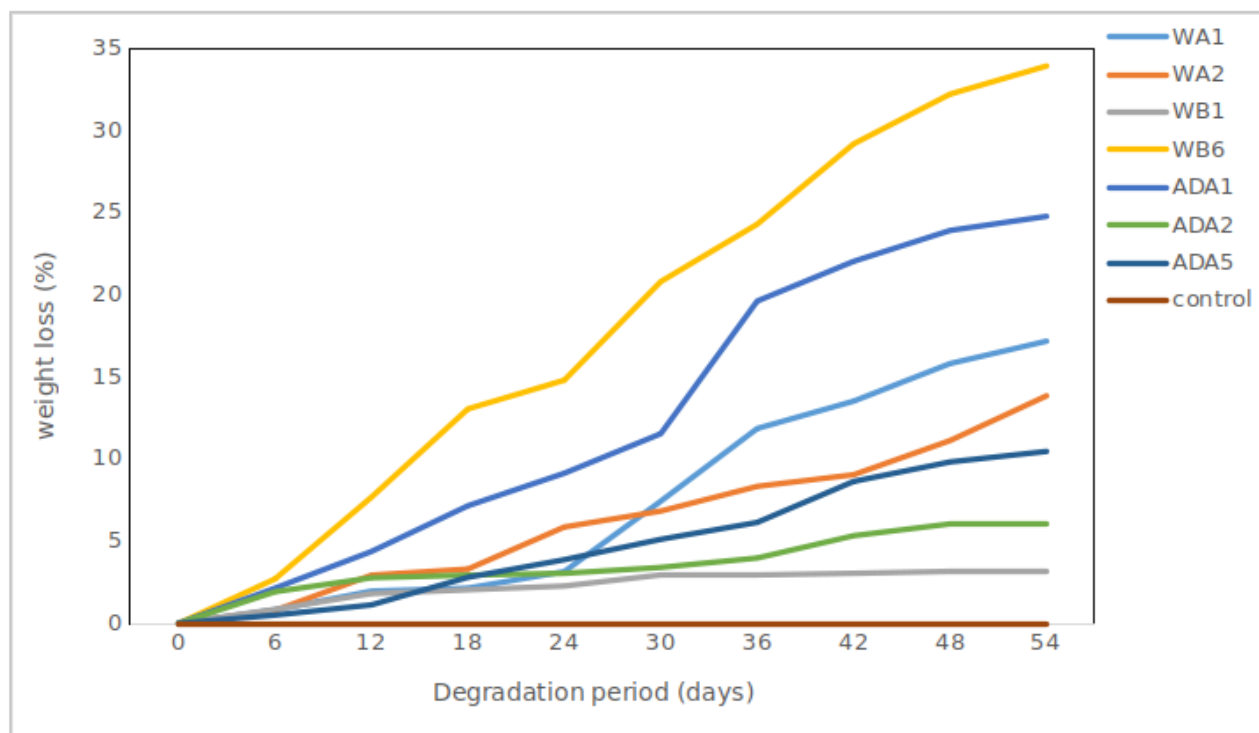


Figure 1. Percentage mass loss of LDPE films incubated with bacterial isolates obtained from natural polymers and of uninoculated control after 54 days.

3.2. Surface characterisation of LDPE films

3.2.1. EDX Analysis Results

EDX measurements of the control film and the films incubated with WB6 and ADA1 are presented in Figure 2(a–c). The carbon contents of the WB6- and ADA1-treated films were 47.90% and 47.75%, respectively, compared with 50.55% for the control. Nitrogen contents were 5.73% and 5.16%, respectively, corresponding to differences of –0.42 and –0.99 percentage points relative to the control. Oxygen contents increased by 0.41 and 1.46 percentage points, respectively. Changes were also observed in sodium and sulfur contents. Table 1 summarizes the reported elemental compositions and their differences relative to the untreated control. These semiquantitative EDX results do not, by themselves, demonstrate assimilation of LDPE by the isolates.

EDX analysis indicated lower relative carbon content and higher relative oxygen content in treated films. The reported O/C ratios were 0.454 for the control, 0.485 for the WB6-treated film, and 0.503 for the ADA1-treated film. These changes are consistent with possible surface oxidation; however, EDX cannot identify individual functional groups or confirm oxidation mechanisms. ADA1 showed a larger change in the reported O/C ratio despite producing less mass loss than WB6. Because EDX is semiquantitative and the samples were exposed to sodium dodecyl solution and a nitrogen- and sulfur-containing medium, residual treatment chemicals may have contributed to the measured elemental signals. The results should therefore be interpreted cautiously.

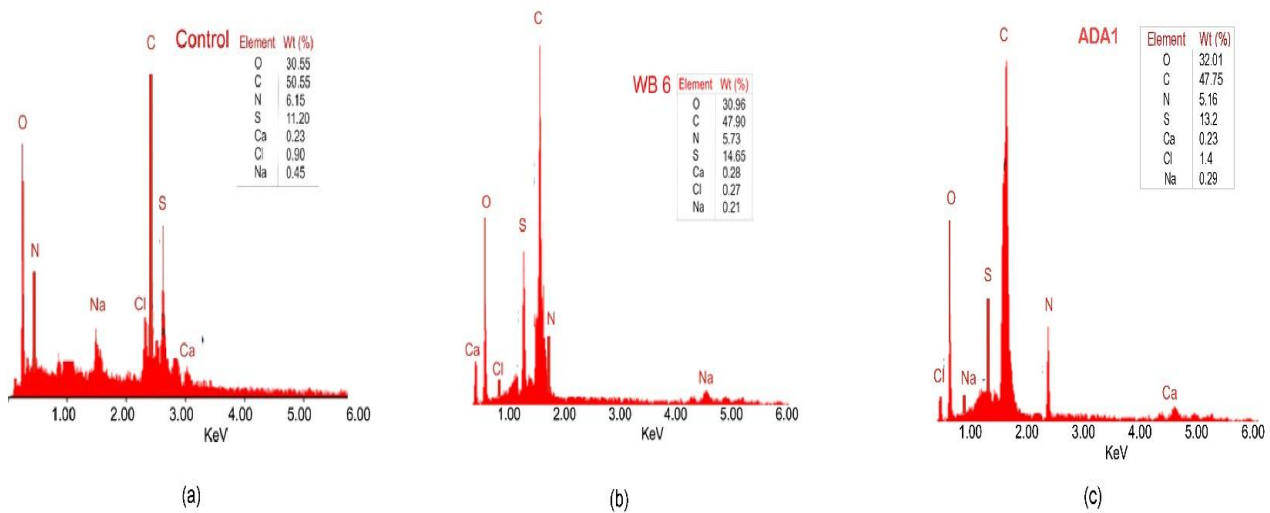


Figure 2. EDX elemental composition of (a) the untreated LDPE control film, (b) the LDPE film incubated with WB6, and (c) the LDPE film incubated with ADA1.

Table 1. Elemental composition of LDPE films after 54 days of incubation with bacterial isolates and reported differences relative to the untreated control.

Element	Elemental Composition (%)		
	Control	WB6 (Difference from control, percentage points)	ADA1 (Difference from control, percentage points)
O	30.55	30.96 (+0.41)	32.01 (+1.46)
C	50.55	47.9 (-2.65)	47.75 (-2.8)
N	6.15	5.73 (-0.42)	5.16 (-0.99)
S	11.20	14.65 (+3.45)	13.2 (+2.00)
Ca	0.23	0.28 (+0.05)	0.23 (0.0)
Cl	0.90	0.27 (-0.63)	1.4 (+0.5)
Na	0.45	0.21 (-0.24)	0.29 (-0.16)

Note: Values in parentheses indicate differences relative to the control in percentage points; +, increase; -, decrease.

3.2.2. SEM Analysis Results

Scanning electron microscopy (SEM) was used to evaluate changes in film surface morphology. Images of the control film are presented in Figure 3(a–c), while images of films incubated with WB6 and ADA1 for 54 days are shown in Figure 3(d–f) and Figure 3(g–i), respectively. The treated-film micrographs show pores, holes, and microcracks. These features suggest surface deterioration during incubation but are not definitive evidence of biodegradation.

Morphological changes in LDPE following microbial exposure have been reported elsewhere. Sanniyasi et al. (2021) observed changes in LDPE films incubated with a microalga, while Sridharan et al. (2021) described cracks and surface disruption. Khandare et al. (2021) also reported surface erosion following exposure to marine bacteria. Samanta et al. (2020) documented increased surface roughness and microbial colonization. Such observations are compatible with surface alteration, but microbial activity, physical damage, polymer additives, and sample

preparation can contribute to the observed features (Chamas et al., 2020; Chatterjee et al., 2010; Montazer et al., 2020).

The SEM images show different surface features in films incubated with the two isolates. WB6 produced the greatest measured mass loss, whereas ADA1 produced the largest reported increase in the O/C ratio. Although these observations may reflect different interactions with LDPE surfaces, the available SEM and EDX data cannot establish distinct degradation pathways. Additional chemical and mineralization analyses would be required to distinguish polymer-chain degradation from surface modification or fragmentation.

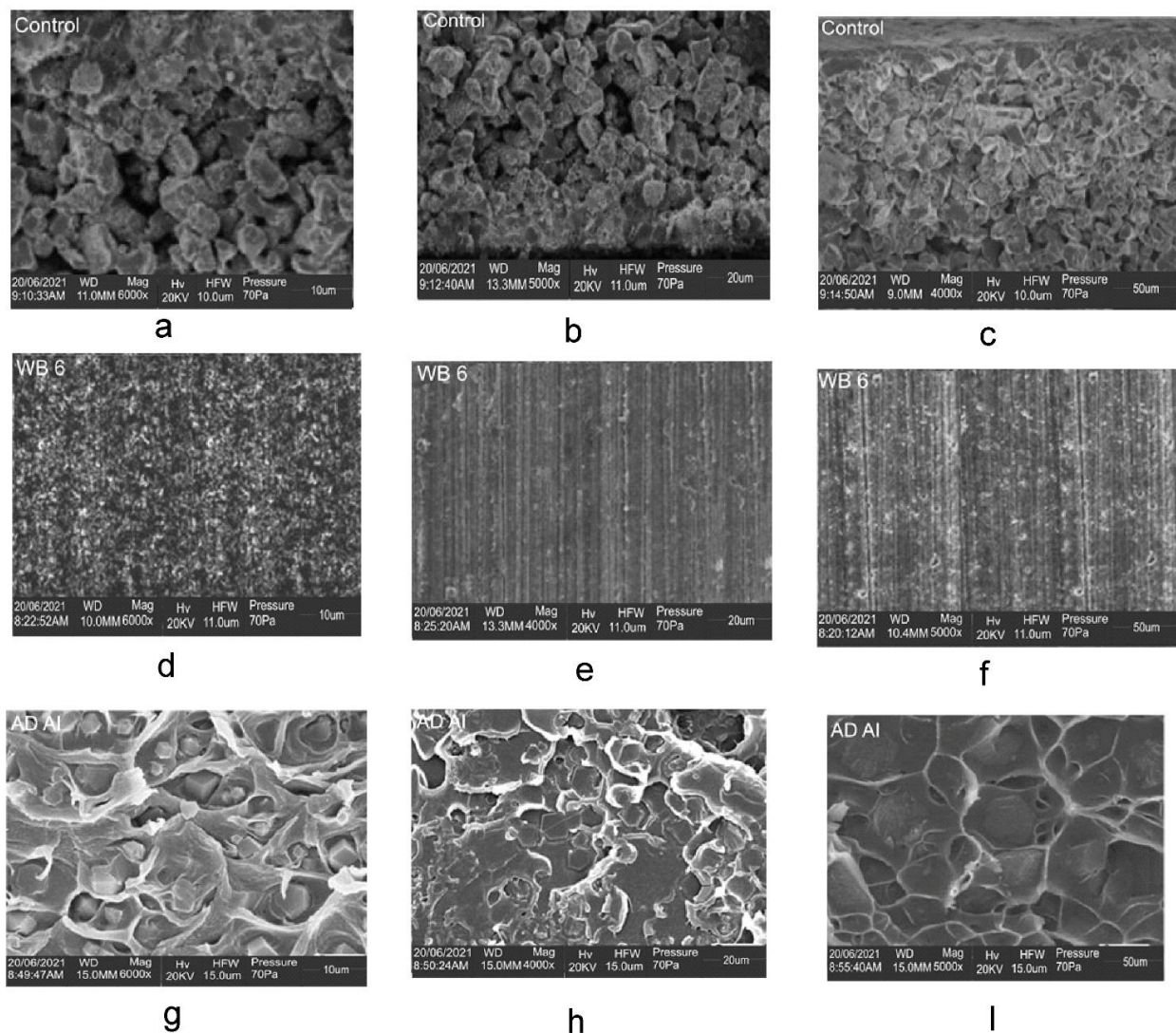


Figure 3. SEM micrographs of (a–c) untreated LDPE film, (d–f) LDPE film incubated with isolate WB6, and (g–i) LDPE film incubated with isolate ADA1. The stated magnifications are 4,000 $\times$, 5,000 $\times$, and 6,000 $\times$, respectively

3.3. 16S rRNA Sequencing of the Isolates

Based on 16S rRNA gene sequence comparisons, isolates WB6 and ADA1 were assigned to *Enterobacter* sp. (closest reported match: *E. cloacae*; GenBank accession MT181602.1; 95.37% sequence identity) and *Alcaligenes* sp. (closest reported match: *A. faecalis*; GenBank accession MZ424652.1; 93.41% sequence identity), respectively. These

sequence identities do not support species-level identification. Further molecular characterization would be necessary to resolve their taxonomic placement.

3.4. Limitations

This study has several limitations. First, the mass-loss measurements were not replicated; therefore, biological variability and statistical significance could not be assessed. Second, the MSM contained 1 g/L glucose, which could have supported bacterial growth independently of LDPE utilization. Third, EDX measurements are semiquantitative, and residual salts or cleaning chemicals may have influenced the elemental signals. Fourth, the reported 16S rRNA sequence identities do not support species-level assignments. The study was also conducted at laboratory scale with only two selected isolates and no field validation. Finally, degradation products, enzymatic activity, biofilm formation, and mineralization were not examined. These limitations constrain conclusions about the extent and mechanisms of LDPE biodegradation.

4. CONCLUSION

Bacterial isolates from pawpaw latex and cashew gum were associated with LDPE film mass losses of 33.91% and 24.79%, respectively, after 54 days of incubation. SEM and EDX analyses revealed differences in surface morphology and elemental composition between treated and control films, providing preliminary evidence of material deterioration under the experimental conditions. However, the absence of independent replication, the presence of glucose in the medium and the lack of degradation-product and mineralisation analyses limit attribution of these changes to bacterial breakdown of LDPE. Future studies should incorporate replicated experiments, appropriate carbon-source controls and direct measurements of polymer-chain changes and mineralisation to confirm biodegradation before practical applications are considered.

ACKNOWLEDGEMENTS

The authors thank McPherson University and the University of Ibadan for providing testing facilities.

AUTHOR CONTRIBUTIONS

Adebisi Enochoghene: Conceptualization, Methodology, Investigation, Validation, Formal Analysis, Writing - Original Draft, Writing - Review & Editing, Supervision; **Godswill Akhigbe:** Conceptualization, Methodology, Formal Analysis, Writing - Review & Editing; **Oluwoleola Ogunkoya:** Investigation, Resources, Data Curation; **Adonis Aruoture:** Investigation, Resources, Data Curation.

FUNDING

This research received no external funding.

DECLARATION OF GENERATIVE AI IN THE WRITING PROCESS

The authors declare that no generative artificial intelligence (AI) tools were used in the preparation of this manuscript.

DATA AVAILABILITY

The data are available from the corresponding author upon reasonable request.

COMPETING INTEREST

The authors declare that there are no competing interests.

COMPLIANCE OF ETHICAL STANDARDS

Not applicable.

SUPPLEMENTARY MATERIAL

Not applicable.

REFERENCES

- Abdelmoez, W., Dahab, I., Ragab, E. M., Abdelsalam, O. A. & Mustafa, A. (2021), Bio- and oxo-degradable plastics: Insights on facts and challenges. *Polymers for Advanced Technologies*, 32(5), 1981–1996. <https://doi.org/10.1002/pat.5253>
- Abraham, J., Ghosh, E., Mukherjee, P. & Gajendiran, A. (2017), Microbial degradation of low density polyethylene. *Environmental Progress & Sustainable Energy*, 36(1), 147–154. <https://doi.org/10.1002/ep.12467>
- Akhigbe, G. E., Enochoghene, A. E., Olumurewa, K. O., Koleoso, O. B. & Ogbonna, N. D. (2023), Characterization of low-density polyethylene (LDPE) films degraded using bacteria strains isolated from oil-contaminated soil. *Environmental Technology*, 45(16), 3155–3161. <https://doi.org/10.1080/09593330.2023.2210770>
- Ammendolia, J., Saturno, J., Brooks, A. L., Jacobs, S. & Jambeck, J. R. (2021), An emerging source of plastic pollution: Environmental presence of plastic personal protective equipment (PPE) debris related to COVID-19 in a metropolitan city. *Environmental Pollution*, 269, 116160. <https://doi.org/10.1016/j.envpol.2020.116160>
- Babayemi, J. O. & Dauda, K. T. (2009), Evaluation of solid waste generation, categories and disposal options in developing countries: A case study of Nigeria. *Journal of Applied Sciences and Environmental Management*, 13(3), 83–88. <https://doi.org/10.4314/jasem.v13i3.55370>
- Bremer, J. R. A. (2022), Aerobic and anaerobic biodegradation. *Journal of Ecosystem & Ecography*, 12(4), 325. <https://doi.org/10.4172/2157-7625.1000325>
- Chamas, A., Moon, H., Zheng, J., Qiu, Y., Tabassum, T., Jang, J. H., Abu-Omar, M., Scott, S. L. & Suh, S. (2020), Degradation rates of plastics in the environment. *ACS Sustainable Chemistry & Engineering*, 8, 3494–3511. <https://doi.org/10.1021/acssuschemeng.9b06635>
- Chatterjee, S., Roy, B., Roy, D. & Banerjee, R. (2010), Enzyme-mediated biodegradation of heat treated commercial polyethylene by Staphylococcal species. *Polymer Degradation and Stability*, 95(2), 195–200. <https://doi.org/10.1016/j.polymdegradstab.2009.11.025>
- Embrandiri, A., Kassaw, G. M., Geto, A. K., Wogayehu, B. T. & Embrandiri, M. (2022), The menace of single use plastics: Management and challenges in the African context. In: Yaser, A. Z., Tajarudin, H. A. & Embrandiri, A. (eds.), *Waste Management, Processing and Valorisation*. Springer, Singapore, pp. 1–21. https://doi.org/10.1007/978-981-16-7653-6_1

- Fotopoulou, K. N. & Karapanagioti, H. K. (2017), Degradation of various plastics in the environment. In: Takada, H. & Karapanagioti, H. (eds.), *Hazardous Chemicals Associated with Plastics in the Marine Environment*. The Handbook of Environmental Chemistry, vol. 78. Springer, Cham, pp. 71–92. https://doi.org/10.1007/698_2017_11
- Gewert, B., Plassmann, M. M. & MacLeod, M. (2015), Pathways for degradation of plastic polymers floating in the marine environment. *Environmental Science: Processes & Impacts*, 17(9), 1513–1521. <https://doi.org/10.1039/c5em00207a>
- Kale, S. K., Deshmukh, A. G., Dudhare, M. S. & Patil, V. B. (2015), Microbial degradation of plastic: A review. *Journal of Biochemical Technology*, 6(2), 952–961.
- Kantharajan, G., Pandey, P. K., Krishnan, P., Bharti, V. S. & Samuel, V. D. (2018), Plastics: A menace to the mangrove ecosystems of megacity Mumbai, India. *ISME/GLOMIS Electronic Journal*, 16(1), 1–5. <http://www.glomis.com>
- Khandare, S. D., Chaudhary, D. R. & Jha, B. (2021), Marine bacterial biodegradation of low-density polyethylene (LDPE) plastic. *Biodegradation*, 32, 127–143. <https://doi.org/10.1007/s10532-021-09927-0>
- Klemeš, J. J., Fan, Y. V., Tan, R. R. & Jiang, P. (2020), Minimising the present and future plastic waste, energy and environmental footprints related to COVID-19. *Renewable and Sustainable Energy Reviews*, 127, 109883. <https://doi.org/10.1016/j.rser.2020.109883>
- Kotova, I. B., Taktarova, Y. V., Tsavkelova, E. A., Egorova, M. A., Bubnov, I. A., Malakhova, D. V., Shirinkina, L. I., Sokolova, T. G. & Bonch-Osmolovskaya, E. A. (2021), Microbial degradation of plastics and approaches to make it more efficient. *Microbiology*, 90, 671–701. <https://doi.org/10.1134/S0026261721060084>
- Liu, X., Gao, C., Sangwan, P., Yu, L. & Tong, Z. (2014), Accelerating the degradation of polyolefins through additives and blending. *Journal of Applied Polymer Science*, 131(18), 40750. <https://doi.org/10.1002/app.40750>
- Meran, C., Ozturk, O. & Yuksel, M. (2008), Examination of the possibility of recycling and utilizing recycled polyethylene and polypropylene. *Materials & Design*, 29(3), 701–705. <https://doi.org/10.1016/j.matdes.2007.02.007>
- Mohanani, N., Montazer, Z., Sharma, P. K. & Levin, D. B. (2020), Microbial and enzymatic degradation of synthetic plastics. *Frontiers in Microbiology*, 11, 580709. <https://doi.org/10.3389/fmicb.2020.580709>
- Montazer, Z., Habibi Najafi, M. B. & Levin, D. B. (2020), Challenges with verifying microbial degradation of polyethylene. *Polymers*, 12, 123. <https://doi.org/10.3390/polym12010123>
- Olanrewaju, O. O. & Oyeade, A. D. (2019), Environmental menace of plastic waste in Nigeria: Challenges, policies and technological efforts. In: *Proceedings of World Environmental Conservation Conference*, pp. 322–333.
- Oluwole, O. A., Oluyeye, J. O. & Olowomofe, T. O. (2022), Biodegradation of polyethylene based films used in water packaging by dumpsite bacteria. *Bioremediation Journal*, 28(1), 1–13. <https://doi.org/10.1080/10889868.2022.2087591>
- Onajobi, I. B., Idowu, E. O., Adeyemi, J. O., Samson, O. J., Ogunyinka, P. I. & Fagade, O. E. (2020), In vitro antibacterial activities and molecular characterization of bacterial species isolated from farmlands against selected pathogens. *Biotechnology Reports*, 27, e00513. <https://doi.org/10.1016/j.btre.2020.e00513>
- Ongia, J. O., Turyabanawe, L., Barasa, B., Mulabbi, A. & Akello, G. (2021), Factors and constraints hindering effective municipal solid waste management systems in Sub-Saharan Africa: Case study of Northern Uganda. *International Journal of Advanced Research*, 3(1), 130–149. <https://doi.org/10.37284/ijar.3.1.431>
- Oyeade, O. J. (2013), Solid waste management for sustainable development and public health: A case study of Lagos State in Nigeria. *Universal Journal of Public Health*, 1(3), 33–39. <https://doi.org/10.13189/ujph.2013.010301>

- Pathak, V. M. & Navneet (2017), Review on the current status of polymer degradation: A microbial approach. *Bioresources and Bioprocessing*, 4, 15. <https://doi.org/10.1186/s40643-017-0145-9>
- Rajeswari, S., Prasanthi, T., Sudha, N., Swain, R. P., Panda, S. & Goka, V. (2017), Natural polymers: A recent review. *World Journal of Pharmacy and Pharmaceutical Sciences*, 6(8), 472–494.
- Raziyafathima, M., Praseetha, P. K. & Rimal Isaac, R. S. (2016), Microbial degradation of plastic waste: A review. *Journal of Pharmaceutical, Chemical and Biological Sciences*, 4(2), 231–242.
- Ru, J., Huo, Y. & Yang, Y. (2020), Microbial degradation and valorization of plastic wastes. *Frontiers in Microbiology*, 11, 442. <https://doi.org/10.3389/fmicb.2020.00442>
- Salami, H. A., Adegite, J. O., Bademosi, T. T., Lawal, S. O., Olutayo, O. O. & Olowosokedile, O. (2019), A review on the current status of municipal solid waste management in Nigeria: Problems and solutions. *Journal of Engineering Research and Reports*, 3(4), 1–16. <https://doi.org/10.9734/jerr/2018/v3i416884>
- Samanta, S., Datta, D. & Halder, G. (2020), Biodegradation efficacy of soil inherent novel sp. *Bacillus tropicus* (MK318648) onto low density polyethylene matrix. *Journal of Polymer Research*, 27, 324. <https://doi.org/10.1007/s10965-020-02296-x>
- Sanniyasi, E., Gopal, R. K., Gunasekar, D. K. & Raj, P. P. (2021), Biodegradation of low-density polyethylene (LDPE) sheet by microalga, *Uronema africanum* Borge. *Scientific Reports*, 11, 17233. <https://doi.org/10.1038/s41598-021-96315-6>
- Shawaphun, S., Manangan, T. & Wacharawichanant, S. (2010), Thermo- and photo-degradation of LDPE and PP films using metal oxides as catalysts. *Advanced Materials Research*, 93–94, 505–508. <https://doi.org/10.4028/www.scientific.net/amr.93-94.505>
- Sridharan, R., Krishnaswamy, V. G. & Kumar, P. S. (2021), Analysis and microbial degradation of low-density polyethylene (LDPE) in Winogradsky column. *Environmental Research*, 201, 111646. <https://doi.org/10.1016/j.envres.2021.111646>
- Torimiro, N., Akhigbe, G. E. & Adebisi, F. M. (2020), Bioprospecting of potential petroleum hydrocarbon degraders using bacterial strains isolated from soils around transformer installation areas. *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*, 46(1), 16110-16123. <https://doi.org/10.1080/15567036.2020.1815906>
- Venkatesan, R., Santhamoorthy, M., Alagumalai, K., Haldhar, R., Raorane, C. J., Raj, V. & Kim, S.-C. (2022), Novel approach in biodegradation of synthetic thermoplastic polymers: An overview. *Polymers*, 14, 4271. <https://doi.org/10.3390/polym14204271>
- Vennila, A., Jayasiri, H. B. & Pandey, P. K. (2014), Plastic debris in the coastal and marine ecosystem: A menace that needs concerted efforts. *IJFAS*, 2, 24–29.



© 2026 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY-NC-ND) license (<http://creativecommons.org/licenses/by-nc-nd/4.0/deed.en>).