(017)

Assessment of the Biodegradation Potential of Commercially Available "Biodegradable" Polymers by Microbial Isolates

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Abstract

Biodegradable products are designed to degrade into valuable metabolites under desirable ecological conditions or in municipal and industrial biological waste treatment facilities. Microbial activity plays a major role in biodegradation. The present study investigated the biodegradability of three commercial products: a biodegradable salad plate (SP), a compostable lunch sheet (LS), and an Oxo-degradable garbage bag (GB) using isolated microorganisms. Microorganisms with potential polymer-degrading activity were isolated and screened through a sequential enrichment protocol under aerobic conditions. Equalized inocula of individual bacterial and fungal isolates were separately introduced to each test sample, and biodegradation was analyzed gravimetrically. Four bacterial and four fungal isolates were selected and inoculated into test samples prepared in minimal salt (for bacteria) and Rose Bengal agar (for fungi). Inoculated flasks and plates were incubated at room temperature in the dark for 60 days under sterile conditions. Recovered test samples were weighed to determine mass loss. Chemical changes were analysed by Fourier Transform Infrared (FT-IR) (ATR mode) spectroscopy. Molecular identification was performed using 16S rRNA (for bacteria) and 5.8S-ITS (for fungi) sequencing. The General Linear Model revealed no significant differences in mass loss percentages between test samples regarding microbial isolate (p=0.073) or material type (p=0.089). The highest mass losses observed were 24.73% in SP, 13.01% in LS, and 14.49% in GB, inoculated with F06, B06, and F14, respectively. FT-IR spectra confirmed the absence of notable chemical modifications. Molecular characterization identified bacterial isolates as *Bacillus* sp. (B06), *B. safensis* (B12), *B. cereus* (B29), and *B. pumilus* (B33), and fungal isolates as *Aspergillus* sp. (F01), *A. fumigatus* (F02), *Paecilomyces variotii* (F06), and *A. tamarii* (F14). The screened bacterial and fungal isolates exhibited measurable biodegradation potential under laboratory conditions, and the activity of *A. tamarii* in degrading LDPE (GB) is commendable. However, chemical degradation was not reported. Further investigations are recommended to optimize conditions to enhance the degradability by microorganisms.

Keywords: *Biodegradable polymers, LDPE, Microbial degradation, Microcosm, Sequential enrichment protocol*