BIODEGRADABLE PLASTIC PERFORMANCE AND DEGRADATION BEHAVIOR IN ENVIRONMENTAL CONDITIONS RELEVANT TO FOOD PACKAGING SYSTEMS

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Introduction and Background

Biodegradable plastics are increasingly promoted as sustainable alternatives to conventional polymers used in food packaging, yet their real environmental performance remains dependent on specific degradation conditions [1]. Recent concerns regarding plastic accumulation in soil and aquatic systems highlight the need to assess whether biodegradable plastics truly offer advantages over traditional materials [2]. The objective of this study is to evaluate the degradation behavior of a biodegradable food-grade plastic compared with paper, conventional plastic, aluminum, and polyethylene in soil, distilled water, and compost, under controlled laboratory conditions.

Material and methods

Samples of each material were cut to equal size and exposed for 35 days to the three media. Mass measurements were performed at 7, 14, 21 and 35 days. Degradation efficiency was expressed as the percentage of mass loss relative to the initial weight. Environmental factors such as moisture, aeration and microbial activity were kept constant for all materials within each medium to ensure comparability.

Results

Biodegradable plastic showed the most significant degradation in compost, reaching approximately 25% mass loss after 35 days, indicating active microbial involvement. In soil, degradation reached around 16%, while in distilled water the material lost only about 7% of its mass, revealing limited degradation potential in aquatic environments. Paper degraded rapidly and completely in both compost and soil, confirming its high environmental compatibility. Polyethylene exhibited moderate degradation only in compost (~45%), but minimal changes in soil and water. Meanwhile, conventional plastic and aluminum showed almost no degradation under any tested conditions, persisting throughout the entire experiment.

Conclusions and implications

The findings demonstrate that biodegradable plastics degrade effectively only in environments rich in microorganisms and oxygen, such as compost. Their limited degradation in soil and aquatic settings suggests that environmental benefits strongly depend on appropriate waste-management infrastructure. Therefore, biodegradable packaging should be integrated with well-developed composting systems to ensure a real ecological impact. The comparison with other materials highlights the importance of selecting packaging not only based on composition but also on end-of-life conditions.

Keywords: *biodegradation, composting efficiency, environmental impact, food packaging materials, polymer degradation, sustainable alternatives*

References

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