Biodegradable polymers: Innovations and environmental impact.

Rajkuberan Prayaj*

Plant Pathology Research Institute, Agricultural Research Center, Giza, Egypt

The proliferation of plastic waste is one of the most pressing environmental issues of our time. Traditional plastics, while versatile and durable, persist in the environment for hundreds of years, contributing significantly to pollution. As awareness of these problems grows, researchers and industries are turning their attention to biodegradable polymers as a promising solution. Biodegradable polymers are designed to decompose more rapidly than conventional plastics when exposed to natural environmental conditions. Unlike traditional plastics, which break down into microplastics, biodegradable polymers degrade into non-toxic byproducts like water, carbon dioxide, and biomass. The degradation process is often facilitated by microorganisms such as bacteria and fungi [1, 2].

Derived from renewable resources like corn starch or sugarcane, PLA is one of the most well-known biodegradable polymers. Recent advancements focus on improving its mechanical properties and thermal stability to broaden its applications, from packaging to medical devices. PHAs are produced by microorganisms through the fermentation of organic materials. They offer a range of properties suitable for various applications, including agricultural films and medical implants. Innovations in PHA production are enhancing yield and reducing production costs, making them more commercially viable. Starch, a natural polymer, is being used to create biodegradable materials that are both cost-effective and environmentally friendly [3].

Researchers are developing new starch-based composites that enhance the mechanical properties and reduce the rate of degradation to suit different applications. This polymer, known for its biodegradability and low melting point, is used in a variety of applications, including drug delivery systems and tissue engineering. Ongoing research aims to optimize PCL's degradation rate and compatibility with other materials. Cellulose, a major component of plant cell walls, is being used to create biodegradable films and coatings. Innovations in cellulose processing are enhancing the performance of these materials, making them suitable for packaging and agricultural applications [4, 5].

Biodegradable polymers offer a solution to plastic pollution by breaking down more rapidly and reducing the accumulation of waste in landfills and oceans. However, their effectiveness depends on proper disposal and environmental conditions conducive to biodegradation. The production of biodegradable polymers often requires substantial amounts of agricultural resources or energy. Balancing the environmental benefits with the resource inputs is crucial to ensuring a net positive impact [6, 7].

Many biodegradable polymers require specific conditions to degrade efficiently, such as those found in industrial composting facilities. The lack of such facilities in many areas can limit the effectiveness of these materials. While biodegradable polymers break down into non-toxic byproducts, the impact of the degradation products on soil and aquatic ecosystems needs further research to ensure they do not cause unintended harm [8, 9].

Biodegradable polymers represent a promising avenue for reducing plastic waste and mitigating environmental impact. Innovations in materials science and production technology are enhancing the performance and applicability of these polymers. However, their successful integration into the waste management system requires addressing challenges related to resource use, waste processing infrastructure, and environmental impact. Continued research and development are essential to maximize the benefits of biodegradable polymers and contribute to a more sustainable future [10].

References

1. Dyo YM, Purton S. The algal chloroplast as a synthetic biology platform for production of therapeutic proteins. Microbiol.2018;164(2):113-21.
2. Economou C, Wannathong T, Szaub J, et al. A simple, low-cost method for chloroplast transformation of the green alga Chlamydomonas reinhardtii. Methods Mol Biol. 2014;1132:401-11.
3. Giraldo JP, Landry MP, Faltermeier SM, et al. Plant nanobionics approach to augment photosynthesis and biochemical sensing. Nat Mater. 2014;13(4):400-8.
4. Liu J, Chang J, Jiang Y, et al. Fast and efficient CRISPR/Cas9 genome editing in vivo enabled by bioreducible lipid and messenger RNA nanoparticles. Adv Mater. 2019;31(33):1902575.
5. Merchant SS, Allen MD, Kropat J, et al. Between a rock and a hard place: trace element nutrition in Chlamydomonas. Biochim Biophys Acta. 2006;1763(7):578-94**.**
6. Lopes ML, Paulillo SC, Godoy A, ét al. Ethanol production in Brazil: a bridge between science and industry. Braz J Microbiol. 2016;47:64-76.

***Correspondence to:** Rajkuberan Prayaj, Plant Pathology Research Institute, Agricultural Research Center, Giza, Egypt. E-mail: rajkuberanprayaj@hotmail.com

***Received:** 20-Nov-2023, Manuscript No. AAAIB-23-144507; **Editor assigned:** 22-Nov-2023, PreQC No. AAAIB-23-144507 (PQ)**; Reviewed:** 04-Dec-2023, QC No. AAAIB-23-144507; **Revised:** 18-Dec-2023, Manuscript No. AAAIB-23-144507 (R)**; Published:** 26-Dec-2023, DOI: 10.35841/aaaib- 7.6.177*

***Citation:** Prayaj R. Biodegradable polymers: Innovations and environmental impact. Arch Ind Biot. 2023; 7(6):177*

7. Wang M, Han J, Dunn JB, et al. Well-to-wheels energy use and greenhouse gas emissions of ethanol from corn, sugarcane and cellulosic biomass for US use. Environ Res Lett. 2012;7(4):045905.
8. Oliveira FM, Pinheiro IO, Souto-Maior AM, et al. Industrial-scale steam explosion pretreatment of sugarcane straw for enzymatic hydrolysis of cellulose for production of second generation ethanol and value-added products. Bioresour Technol. 2013;130:168-73.
9. Manfredi AP, Ballesteros I, Saez F, et al. Integral process assessment of sugarcane agricultural crop residues conversion to ethanol. Bioresour Technol. 2018;260:241-7.
10. Cardona CA, Quintero JA, Paz IC. Production of bioethanol from sugarcane bagasse: status and perspectives. Bioresour Technol. 2010;101(13):4754-66.

Citation: *Prayaj R. Biodegradable polymers: Innovations and environmental impact. Arch Ind Biot. 2023; 7(6):177*