

Bioplastic classifications and innovations in antibacterial, antifungal, and antioxidant applications

ABSTRACT

Conventional plastics exacerbate climate change by generating substantial amounts of greenhouse gases and solid wastes throughout their lifecycle. To address the environmental and economic challenges associated with petroleum-based plastics, bioplastics have emerged as a viable alternative. Bioplastics are a type of plastic that are either biobased, biodegradable, or both. Due to their biodegradability and renewability, bioplastics are established as earth-friendly materials that can replace nonrenewable plastics. However, early bioplastic development has been hindered by higher production costs and inferior mechanical and barrier properties compared to conventional plastics. Nevertheless, studies have shown that the addition of additives and fillers can enhance bioplastic properties. Recent advancements in bioplastics have incorporated special additives like antibacterial, antifungal, and antioxidant agents, offering added values and unique properties for specific applications in various sectors. For instance, integrating antibacterial additives into bioplastics enables the creation of active food packaging, extending the shelf-life of food by inhibiting spoilage-causing bacteria and microorganisms. Moreover, bioplastics with antioxidant additives can be applied in wound dressings, accelerating wound healing by preventing oxidative damage to cells and tissues. These innovative bioplastic developments offer promising opportunities for developing sustainable and practical solutions in various fields. Within this review are two main focuses: an outline of the bioplastic classifications to understand how they fit in as the coveted conventional plastics substitute and an overview of the recent bioplastic innovations in the antibacterial, antifungal, and antioxidant applications. We cover the use of different polymers and additives, presenting the findings and potential applications within the last decade. Although current research primarily focuses on food packaging and biomedicine, the exploration of bioplastics with specialized properties is still in its early stages, offering a wide range of undiscovered opportunities.