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Development of active biodegradable packaging material from fiber-reinforced starch-protein blends for application in food products

Abstract

The increasing demand for sustainable and eco-friendly packaging solutions has driven research into biodegradable materials as viable alternatives to conventional plastic packaging. This research explores the production of active biodegradable packaging films based on fiber-reinforced starch-protein blends incorporated with essential oils. The formulation integrates natural fibers, specifically banana pseudostem and bamboo-shoot fibers, to enhance mechanical strength, structural integrity, and barrier properties. Additionally, active compounds, including cinnamon and clove essential oils, were incorporated to impart antimicrobial and antioxidant functionalities, thereby improving the shelf life of packaged food items. A systematic evaluation of the physicochemical, mechanical, and biodegradability properties of the developed films was conducted. The results demonstrated that fiber reinforcement significantly improved tensile strength, water resistance, and thermal stability, addressing some of the inherent limitations of biopolymer-based films, such as brittleness and poor barrier properties. The incorporation of essential oils further enhanced the films' active properties, effectively inhibiting microbial growth and reducing oxidation, making them particularly suitable for food preservation applications. Biodegradability studies confirmed that the developed films degraded efficiently in natural environments, reducing plastic waste accumulation and environmental pollution.

Overall, this study highlights the potential of fiber-reinforced biopolymer films incorporated with essential oils as a sustainable alternative to conventional plastic packaging. The findings suggest that these active biodegradable films could play a crucial role in the future of food packaging by improving food safety, reducing post-harvest losses, and promoting environmentally responsible packaging solutions. Future research should focus on optimizing formulations to enhance water resistance, evaluating scalability for commercial applications, and integrating intelligent packaging technologies for real-time food quality monitoring.

Development of active biodegradable packaging material from fiber reinforced starch-protein blends for application in food products

by Ditimoni Dutta

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