Harnessing the potential of pineapple stem starch film as a biodegradable packaging material

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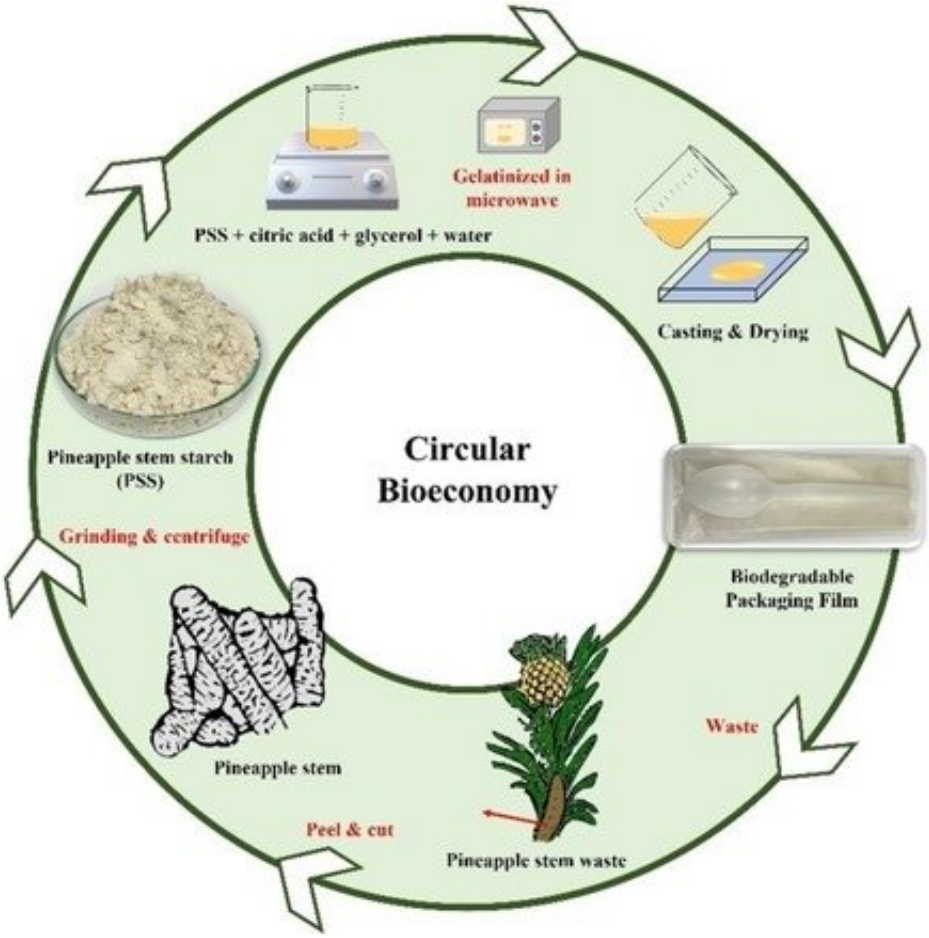

Graphical abstract. Credit: *Membranes* (2023). DOI: 10.3390/membranes13050458

A group of researchers from universities in Thailand and Malaysia have collaborated to develop a unique film that is good for the environment and can decompose naturally. They made this film using leftover pineapple stems, which helps reduce the use of harmful plastic films. This new film has the potential to be used as packaging material, contributing to a more sustainable way of doing business and promoting a circular economy.

In the study published in *Membranes*, Associate Professor Taweechai Amornsakchai from Mahidol University, Thailand led his team of researchers to successfully developed a biodegradable starch film derived from pineapple stem waste, offering a sustainable alternative to non-biodegradable petroleum-based films commonly used for single-use applications that do not require high strength. The key ingredient utilized in this film is high amylose starch extracted from pineapple stems, which serves as the matrix for the material. To enhance its ductility and flexibility, glycerol and citric acid were incorporated as additives.

Maintaining a fixed glycerol content of 25%, the researchers experimented with varying levels of citric acid, ranging from 0% to 15% by weight of starch. This approach allowed for the preparation of films with a wide spectrum of mechanical properties, catering to diverse application requirements. As the concentration of citric acid increased, the resulting film exhibited a softer and weaker nature while demonstrating enhanced elongation at the point of fracture. The mechanical properties of the films spanned a broad range, from a strength of approximately 21.5 MPa with 2.9% elongation, to a strength of about 6.8 MPa with 35.7% elongation.

To gain further insights into the structure of the films, X-ray diffraction analysis was performed, revealing a semi-crystalline nature. Additionally, the films displayed desirable water-resistant properties and the ability to be heat-sealed, opening up potential applications as

packaging materials. To showcase the film's viability for single-use purposes, an exemplar single-use package was successfully demonstrated, underscoring its practicality and versatility.

In order to validate the biodegradability of the material, a soil burial test was conducted. The results unequivocally confirmed that the starch film was biodegradable, as it completely disintegrated into particles smaller than 1 mm within the remarkably short span of one month. This promising characteristic suggests that the film has the potential to significantly mitigate the adverse environmental impact associated with the persistence of non-biodegradable materials.

The development of this biodegradable starch film from pineapple stem waste holds immense promise for addressing the growing concerns regarding the proliferation of non-biodegradable packaging materials. By utilizing an abundant and renewable agricultural byproduct, the researchers have not only offered an eco-friendly alternative but have also contributed to the efficient utilization of resources and waste reduction. Furthermore, the incorporation of glycerol and citric acid additives allows for customization of the film's mechanical properties, enabling it to cater to a wide array of applications where strength requirements are not excessively demanding.

This study serves as a significant milestone in the pursuit of sustainable materials for single-use applications, showcasing the potential of biodegradable films derived from agricultural waste. The findings highlight the importance of exploring innovative approaches to address environmental challenges and emphasize the feasibility of transitioning from petroleum-based materials to renewable alternatives. As the demand for eco-friendly solutions continues to escalate, the development of biodegradable starch films from pineapple stem waste represents a noteworthy contribution to the field of sustainable materials and paves the way for a greener and more sustainable future.

More information: Atitiya Namphonsane et al, Toward a Circular Bioeconomy: Exploring Pineapple Stem Starch Film as a Plastic Substitute in Single Use Applications, *Membranes* (2023). DOI: 10.3390/membranes13050458

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