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Content

BACTERIAL NANOCELLULOSE – NEW BEGINNING FOR END-OF-LIFE PLASTICS

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Introduction: Fossil-based polymers continue to be widely used despite their negative environmental impact. Bioplastics, such as polylactic acid (PLA), offer a promising alternative as they are derived from renewable resources and provide more environmentally friendly end-of-life options. However, marketing PLA as simply biodegradable can be misleading, as the current PLA degradation strategy contributes to microplastics pollution, thus posing even greater threat. This research focuses on the upcycling of PLA degradation products into valuable biomaterial - bacterial nanocellulose.

Methods: PLA samples were pretreated using ultraviolet and ultrasonic waves, individually and in combination, to enhances susceptibility to bacterial degradation. Pretreated PLA was subjected to enzymatic degradation under mild conditions, using various enzyme combinations. The resulting biodegradation products served as a growth medium for nanocellulose producing bacteria *Komagataeibacter medellinensis* ID13488. Obtained nanocellulose was characterized using SEM, FTIR, AFM, and XRD.

Results: The combined PLA pretreatment using ultraviolet and ultrasonic waves, followed by enzymatic degradation with savinase, demonstrated the highest degree of PLA degradation in this study. Furthermore, *K. medellinensis* ID13488 efficiently utilized the biodegradation products, producing nanocellulose with yields and performance comparable to those obtained through standard cultivation using glucose as a carbon source.

Conclusion: This study highlights the potential of combined pretreatment and enzymatic degradation for efficient PLA degradation and sustainable bacterial nanocellulose production. The findings suggest promising avenues for utilizing PLA biodegradation products in the production of other valuable biomaterials. Further research is needed to optimize the pretreatment and degradation processes, facilitating the wider application of biodegradable materials and promoting sustainability.

Key words: PLA; pretreatment; biodegradation; savinase; bacterial nanocellulose

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