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Utilization of seafood waste for potential biomedical applications

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Lobster shell waste was used as the source of raw material to produce chitin using biological treatment, which included the use of co-cultures with a protease-producing bacterium, either Bacillus megaterium NH21 or Serratia marcescens db11, and an organic acid-producing bacterium Lactobacillus plantarum. The optimal culture conditions, including co-cultivation strategies and glucose concentrations, were identified to improve the efficiency of deproteinization and demineralization of lobster shells. The lobster shells were also treated chemically for chitin extraction as comparison to the bio-based treatments. Overall, the successive treatment with a combination of S. marcescens db11 and L. plantarum yielded the best co-removal of $CaCO_3$ and proteins from lobster shell biomass, with total deproteinization of 87.19% and total demineralization of 89.59%. Chitin membranes were successfully prepared by dissolution of this microbially-extracted chitin in ionic liquid 1-ethyl-3-methylimidazolium acetate. The resulting materials were thoroughly characterized, revealing that freeze-drying produced chitin membranes that were highly porous. The drying methods and the concentration of chitin used defined many of the membrane properties, such as mechanical strength, porosity, and water absorbency. A mathematical model was developed to correlate and predict different polymer properties like tensile strength, which would lead to the ability to tune the properties of the biomaterial. Rayleigh's method is often used to develop an expression in the form of an exponential equation to show the functional relationship for a variable that depends on other independent variables. These chitin membranes could potentially be used for biomedical applications such as wound-dressing materials and scaffolds in tissue engineering. The results from the proof-of-concept study described here suggest that microbial treatment may be an environmentally friendly alternative to the chemical method of chitin extraction. This study provides a starting point for the design and fabrication of a family of polysaccharide-based sustainable materials with potentially broad applicability.

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