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Chemical Isolation and Characterization of Cellulose Nanofibers to Produce Bionanocomposite Films onto Chitosan Matrix for Seafood Packaging

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Antimicrobial properties of chitosan films provide a great enhancement in self-life and safety of sea food products. However, chitosan films exhibit poor barrier against water vapor and poor mechanical performance which restrict its wide application in food packaging industry. Therefore, the purpose of this study was to isolate and characterize different cellulose nanofibers (CNFs) from agricultural post harvesting wastes and finally incorporate them onto chitosan matrix to improve both mechanical and barrier performance of bionanocomposite films. Cellulose isolated from cotton stalks was used to prepare four different CNFs by sulfuric acid hydrolysis, TEMPO [(2,2,6,6-tetramethylpiperidin-1-yl) oxy radical]-mediated oxidation, and mechanical treatment followed by ultrasonication. Physical and chemical properties of the prepared CNFs such as morphological (FE-SEM, AFM), structural (FTIR), and thermal gravimetric analysis (TGA) were investigated. TEMPO-mediated oxidation produced brighter and higher yields (>90%) of CNFs compared to other methods. FE-SEM and AFM analysis clearly indicated that, TEMPO-mediated oxidation produced uniform nano-sized fibers with a very small diameter (3–15 nm width) and length (10–100 nm). This was the first time uniform and very small nanofibers were produced. Finally, aqueous suspension of chitosan, sorbitol and TEMPO-CNFs were cast at a room temperature of 23°C and 50% relative humidity. The surface morphology of the films was revealed by FE-SEM and AFM. The thermal properties and crystal structure of the films were evaluated by TGA and X-ay diffraction (XRD). Thus, incorporation of TEMPO-CNFs (5-25%, based on the total dry mixture) into the film resulted in enhanced mechanical properties due to the high aspect ratio and mechanical strength of TEMPO-CNFs and strong interaction between TEMPO-CNFs and chitosan matrix. This effective method makes it possible to produce TEMPO-CNFs/chitosan based biomaterials of high quality.

Biography

Bhawna Soni has completed her Master's degree in Chemistry from India in 2006, and then worked for a R&D company from 2007 to 2012 in Kolkata, India. Currently, she is a second year PhD student at Department of Sustainable Bioproducts in Mississippi State University, working with Dr. El Barbary Hassan in the field of green chemistry. She has published her first paper in carbohydrate polymers and is writing her second paper in order to publish in a reputed journal.

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