Synthesis of Cellulose Nano Fiber from Palmyrah Fruit Fiber and Its Use as a Reinforcement Agent on Starch Based Biodegradable Film

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Global trend in packaging is shifting towards environmentally friendly, natural materials that can be decomposed easily. Among the bio-based packaging materials, starch is a renewable, biodegradable, bio-compatible and easily accessible source. However, starch-based biodegradable films depict weaker mechanical properties compared with synthetic polymers. This problem can be solved by incorporating reinforcement fillers into the starch matrix. Palmyrah fruit (*Borassus flabellifer L.*) waste can be a good source to obtain fillers due to its high cellulose content. The aim of the study was to investigate the reinforcement of starch-based biodegradable films with the incorporation of pure cellulose nanofiber (CNF) obtained from palmyrah fruit fiber (PFF). Chemical treatments such as alkaline treatment, bleaching, and acid hydrolysis were done successively to obtain pure CNF from PFF. CNF was characterized using FTIR and particle size distribution (PSD) was analyzed by granulometry. The results of FTIR depicted CNF was synthesized successfully. Five different biodegradable films were prepared by varying the amount of palmyrah tuber starch (4.5-2.5 w/w %) and CNF (0.0-2.0 w/w %) while the amount of glycerin (1.5 w/w %) and gelatin (1 w/w %) were kept constant. The yield of CNF from PFF was 37.89 ± 0.008 %. PSD results revealed that nano-sized CNF (10-100 nm) was synthesized successfully. Optimized film was selected based on the tensile strength and low water vapor transmission rate. Optimized film formulation, with palmyra tuber starch (3 w/w %) and CNF (1.5 w/w %) showed desirable physical, mechanical and optical properties, including the thickness, moisture content, water vapor transmission rate, water uptake, transparency at 600 nm, water activity, water solubility and tensile strength of 0.192 ± 0.004 mm, 11.07 ± 0.04 %, 3.87 ± 0.005 g/m2.day, 22.34 ± 0.05 %, 3.97 ± 0.01 %, 0.44 ± 0.001, 51.68 ± 0.140 % and 9.55 MPa respectively. All films showed excellent soil biodegradability within two weeks period. In conclusion, palmyrah fruit CNF can be effectively used to reinforce starch based biodegradable packaging films.

Keywords: Cellulose Nanofibers, Palmyrah Tuber Starch, Tensile Strength, Water Vapor Transmission Rate