Development and Characterization of Sodium Alginate-Based Packaging Reinforced with Sansevieria Zeylanica Fibers

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Almost all consumer products require packaging to keep them safe and protected from microorganisms and environmental conditions. Most of the packaging materials are made from plastics and other petroleum by-products. They last for a long time and cause severe problems to the environment. Packaging removal represents the large content of garbage that we throw away. Thus, finding eco-friendly alternatives is important for the conservation of the environment. The non-biodegradable nature of current packaging materials causes increased waste generation and ecological harm. This work aims to develop an eco-friendly packaging material by reinforcing biodegradable sodium alginate sheets with bleached, alkali-treated Sansevieria zeylanica fibers. The goal is to enhance the mechanical strength and water vapor transmission rate of the sheets, thereby reducing dependence on non-renewable resources. After biological retting, extracted Sansevieria zeylanica fibers were chemically treated with sodium hydroxide and hydrogen peroxide to remove lignin and hemicellulose. Fibers with the ideal mechanical strength, water content, and solubility were found through optimization using solution casting synthesis of sheets prepared using the extracted and chemically treated fibers. After that, these fibers were mixed with glycerol, water, and sodium alginate, formed into sheets using glass trays, and allowed to air dry for 48 hours (solution casting). The resulting composite sheets were evaluated for mechanical strength, thickness, and water vapor transmission rate. The removal of lignin and hemicellulose was validated by FTIR analysis. Significant parameters affecting the properties of composite sheets were identified using statistical techniques such as ANOVA and Duncan's test. FTIR ensures the removal of lignin and hemicellulose. At 10.0M, the ideal fiber concentration provides a maximum strength of 17.41 MPa. Changing fiber masses offer less water content and tailored packaging. There was the enhancement of certain properties with the increment of the applied fiber mass. Water Vapor Transmission Rate (WVTR) was decreased from 63×10^{-4} gm^{-2} s^{-1} to 45×10^{-4} gm^{-2} s^{-1}, the water content of the sheets reduced from 17% to 10%, and water solubility decreased from 100% to 45%. However, the increase in the fiber mass caused an increase in the mechanical strength from 5.53 MPa to 21 MPa.

Keywords: Sodium Alginate, Sustainable Packaging, Natural Fillers, Composites, Plant Fiber