Synthesis and Characterization of Cellulose Acetate Polymer From Pinus spp. Pine Cones

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Due to the growing demand for sustainable materials and the need to reduce the environmental impact of conventional polymers, this study aims to the use of Pinus spp. pine cones, an underutilized agro-industrial waste, as an alternative cellulose source for cellulose acetate synthesis. The objective was to develop an efficient process for this conversion, evaluating its technical feasibility and quality. Besides, the results suggest that the cellulose content of the pine cones is comparable to that of Pinus wood, validating its potential as a raw material. The process involved the purification of the pine cones using two distinct methodologies described in the literature, applied sequentially, followed by polymer synthesis. The material characterization was performed by using the Fourier Transform Infrared Spectroscopy (FTIR) to confirm biopolymer formation and assess delignification efficiency. Additionally, acid-base retro-titration and Thermogravimetric Analysis (TGA) were used to determine the degree of substitution and the thermal properties of the polymer. The results indicate that the cellulose content in the pine cones is comparable to that of Pinus wood, confirming its viability as a source. FTIR analysis demonstrated effective delignification and cellulose acetate formation, while retro-titration indicated that the biopolymer obtained is monosubstituted. TGA, in turn, suggests that the material may be a mixture of monoacetate and diacetate cellulose. Thus, the data demonstrate that Pinus spp. pine cones are a viable source of cellulose for the synthesis of cellulose acetate, highlighting the feasibility of the process and the need for optimization to enhance its efficiency and industrial applicability.

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