

Effect of Sulphuric Acid Concentration on Nanocellulose Derived from Pineapple Peels

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Structured Abstract

Background: Pineapple peel, which is often discarded as agricultural and industrial waste, is rich in cellulose and holds significant potential as a source for producing nanocellulose. Nanocellulose is highly valuable in fields such as packaging, biomedicine, and composites due to its exceptional mechanical strength, biodegradability, and crystalline structure. Optimising the extraction of nanocellulose via sulphuric acid hydrolysis is crucial, as acid concentration directly affects yield, structural properties, and thermal stability. This study investigates the impact of varying sulphuric acid concentrations (10%, 20%, and 30%) on nanocellulose fibres extracted from pineapple peels.

Methods: Pineapple peels were first treated with alkali peroxide and subsequently bleached to remove lignin and hemicellulose. The pretreated material was then hydrolysed using 10%, 20%, and 30% sulphuric acid. The resulting nanocellulose was freeze-dried and analysed using Fourier Transform Infrared Spectroscopy (FTIR) and Thermogravimetric Analysis (TGA). Yield calculations were performed to evaluate the extraction efficiency at different acid concentrations.

Results: FTIR confirmed successful extraction, as evidenced by characteristic cellulose peaks and a decrease in non-cellulosic content as acid concentration increased. The TGA results revealed that the nanocellulose treated with 10% acid had the highest thermal stability at 285.97 °C, while the 30% sample exhibited the lowest stability at 244.91 °C. This difference is likely due to the presence of sulphate ester groups and shorter cellulose chains. Although the 30% solution yielded the highest amount of nanocellulose (7.19%), it compromised thermal performance.

Conclusion: In conclusion, the concentration of sulphuric acid plays a crucial role in determining the yield, functional properties and thermal stability of nanocellulose derived from pineapple peels. There is a clear trade-off between yield and thermal performance, highlighting the need to optimise extraction conditions.

Keywords: Nanocellulose, pineapple peel, sulphuric acid, cellulose

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