

Characterization of Microcrystalline Cellulose from Calamansi Lime Peel

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Structured Abstract

Background: The global processing of citrus fruits generates increasing amounts of waste, including peels, seeds, and pomace, which can lead to unsanitary conditions and potential health hazards. Calamansi peels are a commonly discarded byproduct of this process. The purpose of this research is to analyze microcrystalline cellulose (MCC) generated from Calamansi peel waste using alkaline, bleaching and acid hydrolysis method. The characterization of microcrystalline cellulose (MCC) derived from calamansi peels involved analysing its physical, chemical, and structural properties to assess its quality and potential applications, thereby promoting sustainability and waste minimization.

Methods: Raw materials underwent washing, heating, filtration and drying processes. CLP were processed through alkaline treatment with 4% sodium hydroxide (NaOH) at 80°C and bleaching treatment with 5%(w/v) sodium chlorite (NaClO₂) at 60°C. The cellulose obtained further processed acid hydrolysis steps using 2.5% hydrochloric acid (HCl) at 80°C to obtained MCC. The resulting cellulose and MCC samples were characterized using FTIR, SEM and XRD techniques. In addition, lignocellulosic composition and yield were determined.

Results: The chemical composition analysis of CLP revealed a holocellulose content of 8.61%, hemicellulose content of 1.59%, and lignin content of 15.39%, while the remaining 67.39% comprised other compounds such as oil and pectin. The color changes after alkaline and bleaching treatments indicate successful lignin removal. The extracted cellulose was converted into MCC achieving a yield of 27.08%. Characterization using FTIR proved the removal of lignin and hemicellulose functional groups, SEM shows a denser morphology and XRD confirmed MCC exhibited higher crystallinity (74.07%) than cellulose (68.15%).

Conclusion: This study successfully analysed the chemical composition of CLP, extracting and characterized MCC. These findings demonstrate that CLP is a promising, eco-friendly source of MCC with potential applications across multiple industries while contributing to agricultural waste reduction.

Keywords: Cellulose, MCC, alkaline, bleaching, acid hydrolysis

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