

Extraction of Microcrystalline Cellulose from Banana Peels and its Application in Biodegradable Film

Raja Diyana Syafia Raja Kamaruzzaman^a, Maryam Husin^{a*}

Structured Abstract

Background: Over the years, there has been a noticeable rise in the worldwide usage of plastics. Most plastics made from petroleum are not biodegradable, they end up in landfills for a long time and contribute to plastic pollution. Fruit peel waste contributes to 15–60% of total fruit waste and tends to be dumped, they can pollute the environment and pose health risks if not properly managed. This study utilized banana peels which is considered fruit waste to extract Microcrystalline Cellulose (MCC), which acts as a filler in a biodegradable film. The study aimed to characterize the properties of MCC derived from banana peel powder (BPP) and to investigate the effect of MCC as filler in starch-based film.

Methods: MCC from BPP was extracted through several chemical treatments, including dewaxing, alkali, bleaching, and acid hydrolysis. FTIR, XRD, and SEM analysis were used to verify its structure and characteristics. MCC was then mixed into starch-based films, which were subjected to 5, 10, and 15 days of soil burial tests to evaluate their mechanical characteristics and biodegradability. The starch-based film enforced with MCC also subjected to water absorption test to evaluate its resistance to water.

Results: FTIR test confirmed the high crystallinity of MCC, resulting from the removal of amorphous substances. XRD analysis revealed that the crystallinity index of MCC (58.43%) is slightly higher than that of cellulose (47.46%), supporting the efficiency of acid hydrolysis process. SEM images showed that MCC had a smoother surface in comparison to the BPP and cellulose. Biodegradability tests indicated rapid degradation of films without MCC after 15 days of soil burial, while film enforced with MCC still has its structure stability. Water absorption tests showed decreased water uptake with the presence of MCC.

Conclusion: In conclusion, the results of this study indicate that MCC enhanced the mechanical and barrier properties of film. The results highlight the potential of banana peels as a sustainable source for MCC as filler for improving the properties of biodegradable films, which can be used as eco-friendly alternatives to standard plastic materials.

Keywords: Banana Peel, Microcrystalline Cellulose, Biodegradable Film, Starch-Based Film

*Correspondence: marya911@uitm.edu.my

^a School of Chemistry & Environment, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia