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Effects of N, N'-Methylenebisacrylamide (MBA) and Glutaraldehyde (GA) Crosslinking Agents on the Physicochemical and Thermal Characteristics of Hemicellulose Hydrogel from Oil Palm Empty Fruit Bunches (OPEFB)

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Structured Abstract

Background: This study explores the synthesis of hemicellulose-based hydrogels from Oil Palm Empty Fruit Bunches (OPEFB), focusing on how variations in crosslinker concentrations—N,N'-Methylenebisacrylamide (MBA) and Glutaraldehyde (GA)—affect their physicochemical and thermal properties.

Methods: Hemicellulose was extracted using microwave assistance and an alkaline solution at 130°C for 30 minutes. Hydrogels were synthesized via free radical polymerization, incorporating different concentrations of MBA and GA to evaluate their impact on the hydrogels' swelling behavior and thermal and structural properties.

Results: Hydrogels crosslinked with 0.01 g of MBA exhibited the highest swelling ratio at 615%, indicating a less dense network and enhanced water absorption capability. Conversely, GA-crosslinked hydrogels demonstrated intermediate swelling extents, suggesting denser crosslinking. Fourier-transform infrared spectroscopy (FTIR) confirmed successful crosslinking by detecting key functional groups (O-H, C=O, and C-N). X-ray diffraction (XRD) analysis revealed that the hydrogels primarily retained an amorphous structure. Thermogravimetric analysis (TGA) highlighted increased thermal stability with higher crosslinker concentrations, demonstrating their significant influence on the hydrogels' structural integrity.

Conclusion: The study confirms that OPEFB-derived hydrogels can be effectively tailored for enhanced functionality using specific crosslinker types and concentrations. These hydrogels show promise for various applications, including drug delivery, wound healing, and environmental cleanup, due to their sustainable properties and the ability to customize their physical and chemical characteristics for specific needs. Optimizing crosslinker volumes and processing parameters is essential to maximize the hydrogels' practical applications.

Keywords: Hemicellulose Hydrogel, MBA, GA, Crosslinking, OPEFB

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