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ORIGINAL RESEARCH

Green disassembly: direct preparation of cellulose micronised powder from hemp by deep eutectic solvent

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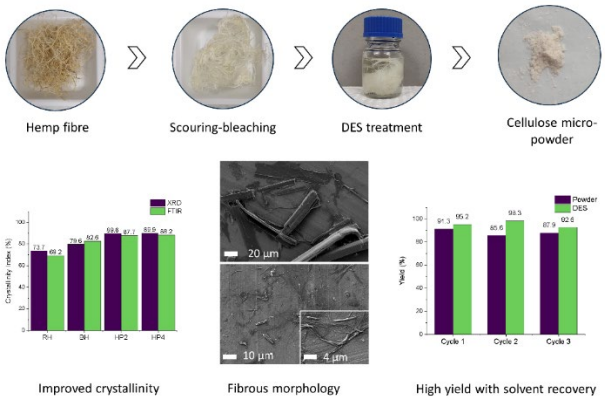
This study introduces a sustainable and mechanically passive approach to producing cellulose micronised powder from hemp fibres using a choline chloride/lactic acid-based deep eutectic solvent (DES). The DES treatment disrupted the fibre matrix, improved surface purity, and enhanced cellulose crystallinity without relying on any mechanical grinding or milling stages. Characterisation through scanning electron microscopy (SEM), Atomic force microscopy (AFM), Fourier-transform infrared (FTIR) spectroscopy, Energy-dispersive X-ray spectroscopy (EDX), and X-ray diffraction (XRD) confirmed superior structural uniformity and purity in the DES-treated samples compared to raw and conventionally bleached hemp. The particle size distribution revealed a significant reduction in median size, ranging from 8.4 to 39.5 µm. Crystallinity was markedly improved in treated samples, affirming the removal of lignin and hemicellulose. FTIR results confirmed the removal of non-cellulosic parts and esterification of cellulose, while EDX results further supported this outcome, with elemental profiles closely aligns with theoretical cellulose composition. Additionally, the DES system demonstrated excellent reusability over three cycles, maintaining high solvent recovery (>92%) and consistent powder yield (78–91%), confirming its practical applicability. Overall, this work offers a green and scalable route for producing cellulose powder from hemp, with potential applications in polymer reinforcement, coatings, and other bio-based materials.



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