Bacterial Nanocellulose from Kombucha By-Products: a Renewable Source for Green Hydrogels

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Adopting green and sustainable approaches in material science is essential to minimize environmental impact and foster innovation. Hydrogels, known for their high-water content, tunable properties, and responsiveness, have widespread applications, yet conventional hydrogels often rely on non-renewable resources and harmful processes. This study focuses on developing eco-friendly hydrogels by recycling bacterial nanocellulose (BC) from by-products of kombucha drink production. These materials were purified and characterized, revealing a nanofibrous porous network, high crystallinity and purity, and significant water-holding capacity (WHC), while mechanical testing showed good resistance and viscoelasticity. Their potential was explored in cultural heritage conservation, where a formulated BC organogel effectively removed hydrophobic substances, and an EDTA-loaded BC hydrogel successfully removed copper corrosion from stone surfaces. The bacterial nanocellulose hydrogels demonstrated great effectiveness and possess good potential as sustainable and innovative alternatives to conventional materials in various fields.