Bacterial Nanocellulose-Laponite Composites for Controlled Drug Release and Wound Dressings

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Bacterial nanocellulose (BNC) shows promise properties for biomedical applications like tissue engineering scaffolds and wound dressings [1]. Laponite (Lap) clay is widely studied for drug delivery due to its high adsorption capacity, cation exchange properties, and ability to protect active compounds [2]. This study developed BNC/Lap composites (1-50% w/w) for multifunctional dressings with modified antibiotic release.

BNC membranes were compression-dehydrated, rehydrated with Lap suspensions, and dried (72h) to create BNC/Lap 1-50% composites. Characterization included SEM, synchrotron 3D ptychography, and USAXS. Biological evaluation assessed cell viability (HDFa fibroblasts), ciprofloxacin adsorption/release, and antibacterial activity (*E. coli* and *S. aureus*).

SEM showed all composites maintained nanofibrous structures, with increasing fiber aggregation at higher Lap content. 3D ptychography revealed progressive structural compaction with clay addition. USAXS quantified fibril bundle diameters: 57 nm (BNC), 57 nm (5% Lap), 60 nm (10%), 63 nm (15%), and 66 nm (30%). All materials showed >70% cell viability. Drug adsorption increased from 42 mg/g (BNC) to 90.3, 81.9, and 76.5 mg/g for 15%, 30%, and 50% Lap composites, respectively. Release profiles demonstrated controlled delivery: BNC released 87.2% ciprofloxacin in 24h versus 59.8% (10% Lap), 44.2% (15%), and 56.2% (30%). All samples inhibited *E. coli* and *S. aureus* growth, with larger inhibition zones (1.4 cm diameter) than positive controls (0.5cm).

BNC/Lap composites exhibited more compact fibers structures and superior drug adsorption versus pristine BNC. The materials showed a controlled release kinetics, biocompatibility (>70% HDFa viability), and significant antibacterial activity. These results demonstrate their potential as multifunctional wound dressings with antibacterial properties.

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References
[1] 10.1016/j.carbpol.2016.07.059

[2]10.1016/B978-0-323-46153-5.00014-8