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A functionalized nanobiopolymer as an alternative for burn wound dressing

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Introduction

Burn wounds present higher risk of infection due to extensive damage suffered by the skin and can be dry or wet. Dry burn wounds require moisture environment while wet burn wounds produce exudate needing recurring wound dressing exchange. In both situations, the wound dressing replacement commonly causes excruciating pain. Bacterial nanocellulose (BNC) displays less wound adhesion, provides ideal moister and antimicrobial properties when functionalized with an antibiotic, gentamicin (**Figure 1**).

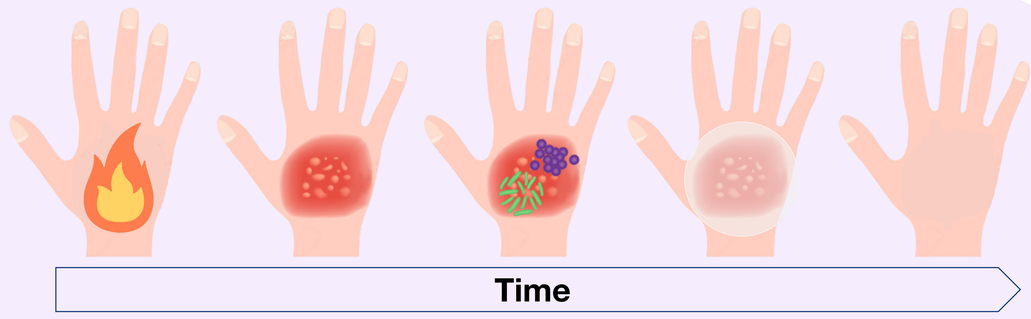

Figure 1. The healing process of a burn wound using functionalized BNC with gentamicin.

Results and Discussion

BNC was produced by static fermentation of *Novacetimonas hansenii.* After purification, BNC was functionalized with gentamicin through exhaustion (overnight, 37°C). Subsequently, the composites were evaluated through scanning electron microscopy (SEM) (**Figure 2**). It is possible to see gentamicin (BNC + Gentamicin) at the surface and cross-sectional views

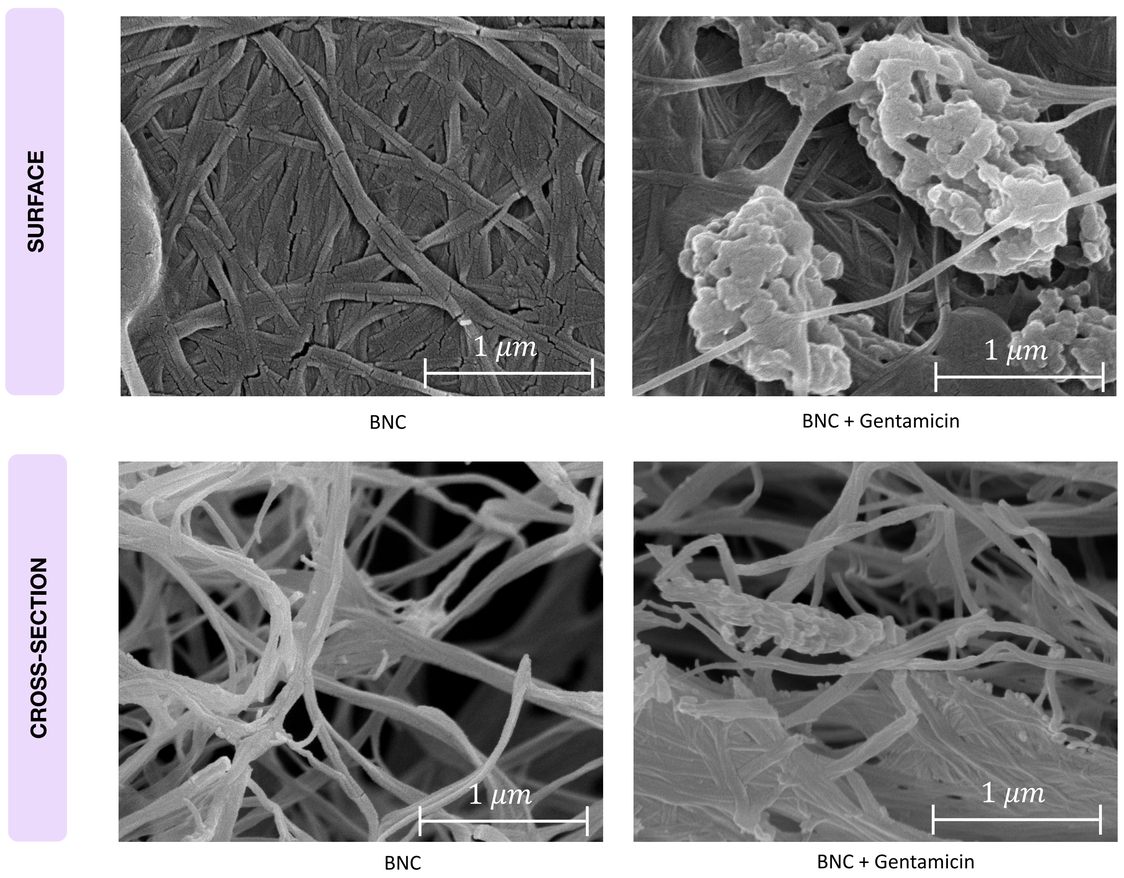

Figure 2. SEM Images of the developed composites.

Gentamicin is used against common pathogens in burn infections: *Pseudomonas aeruginosa* and *Staphylococcus aureus*. The functionalized BNC denoted a sterilization level (> 6 log-reduction, AATCC 100 TM 100 adapted) for these bacteria (**Figure 3**).

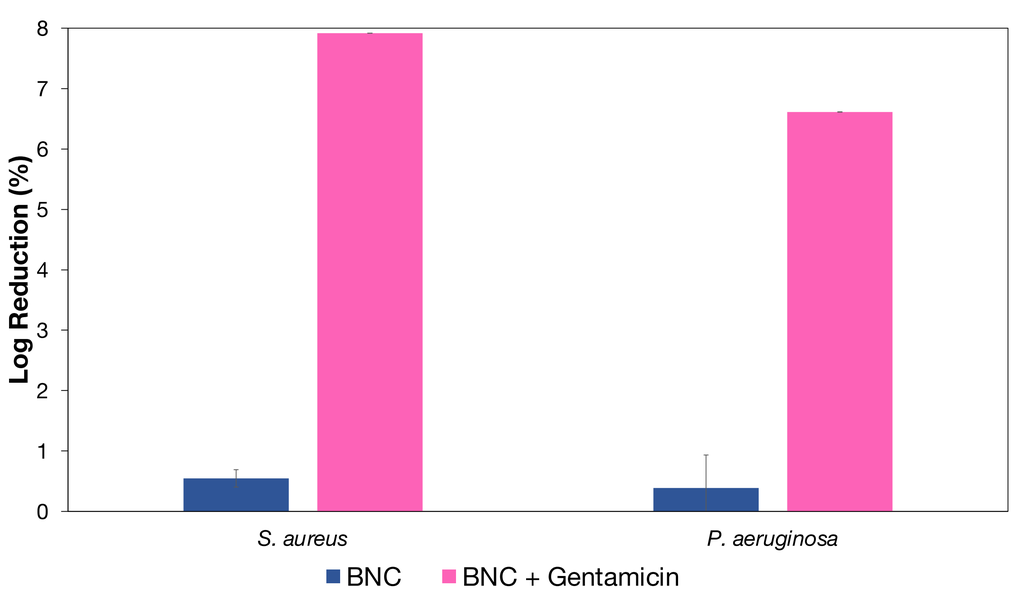

Figure 3. Antimicrobial results of the developed composites.

The delivery of gentamicin onto the wound was evaluated over seven days (**Figure 4**). An initial burst release of 20% (2h) from the total 24% (8h).

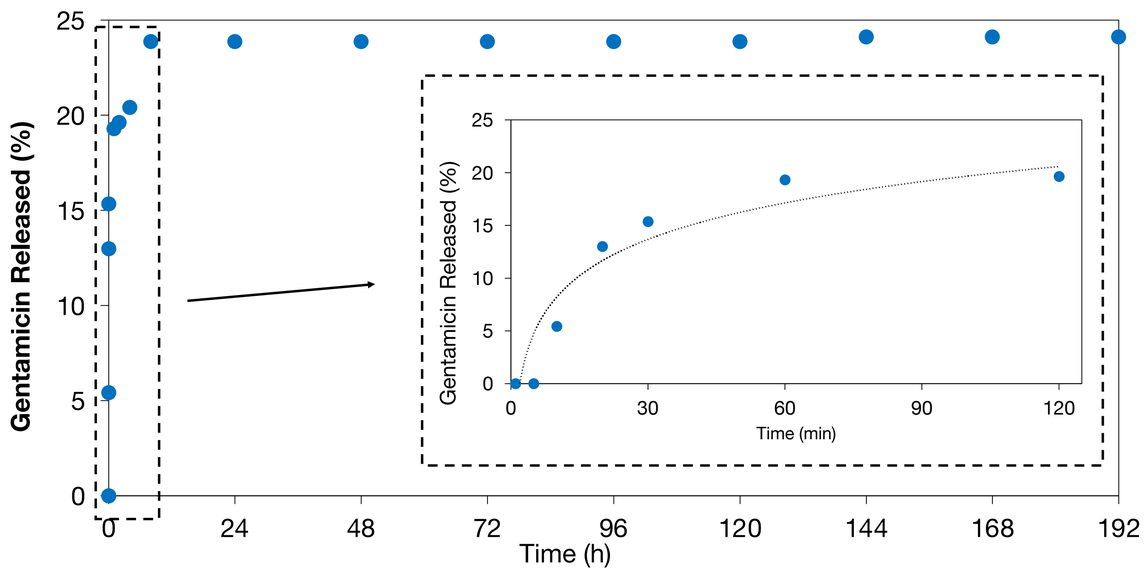

Figure 4. Release test results of the developed composites.

Finally, swelling was determined to evaluate its absorption performance. A gain of 400% from its original weight was observed (**Figure 6**). Furthermore, pristine BNC absorbed 27% and 90% of the saline solution (SS, ●) and exudate (EXS, ●) after 96 h, respectively. The functionalized BNC present lower absorption capacity in both cases (for SS, ●, and EXS, ●).

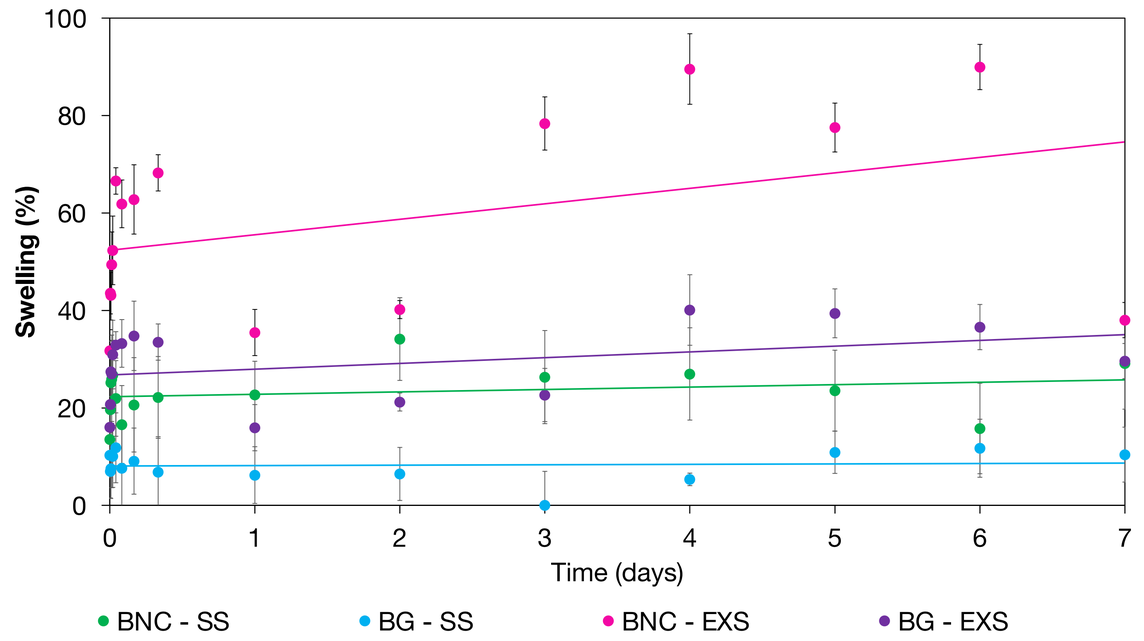

Figure 6. Swelling test results of the developed composites.

Conclusion

BNC functionalized with gentamicin as a burn wound dressing, displayed:

→ Controlled release of the antibiotic, which is 88.48% below toxic levels (1.2 mg/m);

→ Absorbance capacity of approximately 50% of the exudate;

→ Rapid dehydration levels, adequate for wet wounds;

→ In the case of dry wounds, users may add saline solution;

→ Sterilizing activity against critical pathogen species found in burn wounds;

→ A dehydration assay was performed with the functionalized BNC reaching 50% and 100% of dehydration after 2 h and 4 h, respectively (data not shown).

Acknowledgments
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