Electrospun Nanofibers Containing Antimicrobial Peptides for Bio-film Prevention

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Abstract

Biomaterial-associated infections remain a serious concern in modern healthcare. The development of materials that can resist or prevent bacterial attachment constitutes a promising approach to dealing with this issue [1]. Promising solutions include electrospun fibres based on environmentally friendly polymers such as poly(acrylic acid) (PAA) and polyvinyl alcohol (PVA), which offer the advantage of their high surface area, chemical tenability and biocompatibility [2]. Antimicrobial peptides (AMPs) have been the focus of great interest in recent years owing to a low propensity for bacterial resistance, broad-spectrum activity, high efficacy at very low concentrations, target specificity, and synergistic action with classical antibiotics [1].

In this study, three potent AMPs (nisin, e-poly-lysine and lysozyme) were incorporated into PAA/PVA electrospun fibers via self-assembly for bio-film prevention. For this end, different immobilization conditions were employed. The specimen formulations were tested for: (i)surface characterization, by SEM, ATR-IR, nitrogen content, ζ-potential and fluorescamine assay; (ii)antibacterial activity with *Staphylococcus aureus* during two weeks, by agar diffusion and liquid incubation measurements of bacterial outgrowth; (iii)anti-biofilm activity by live/dead staining and SEM observation; (iv)mode of action by live/dead staining and (v)AMPs release profile by HPLC.

The amount of AMPs incorporated per unit mass of fibers was considerably larger when using ph7 conditions insteag of ph10 conditions and a higher degree of peptides loading was observed for lysozyme. The antimicrobial activity increased with AMPs content and time exposure, but the effect was much more apparent for lysozyme than for nisin and ε-poly-lysine. *S. aureus* decrease in CFU amounted to < 90% in liquid culture and over 99% for bacteria adhered to membrane surface. Figure 1 shows neat PAA/PVA meshes colonized by *S. aureus* (left) in contrast to PAA/PVA-Lysozyme meshes, which are essentially free of bacteria.
Based on the results of this study, PAA/PVA-Lysozyme immobilized nanofibers hold great promise for their use as alternatives to conventional wound dressing materials.

References

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[2] Santiago-Morales J., Amariei G., Letón P., Rosal R., Colloids Surf., B. 146(2016), 144-151

Figures

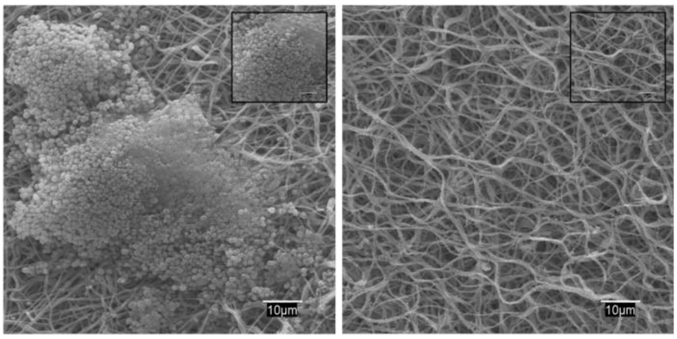

Figure 1: SEM micrographs of neat (left) and modified PAA.PVA (right) membranes in contact (14d) with cultures of *S.aureus.*