

Abstract

Urinary tract infections (UTIs) have placed tremendous stress on public health sector. UTIs reported as the fourth most common type of healthcare-associated infection, making up 12.9% of such infections among which more than half are associated with catheter. In this work antimicrobial peptides (AMPs) derived from *Lycosa erythrognatha* spider venom, particularly LyeTx I mnΔK was assessed against UTIs.

Bacteriostatic and bactericidal properties of AMP were assessed, and its docking was performed with the adhesin of UPEC. The antibiofilm effects of the AMP were evaluated using the microplate-based model and catheter-based model. The toxicity of AMP was tested *in vitro* and in animals as well. Subsequently, AMP was coated on medical grade silicon using the ultrasonic spray method in the presence of polymer. The coatings were characterized through scanning electron microscopy (SEM), energy-dispersive spectroscopy integrated with SEM, Fourier-transform infrared spectroscopy (FTIR), contact-angle analysis and tested for antimicrobial effects.

The results showed that LyeTx I mnΔK stands out as a highly active AMP against UPECs, hypothetically due to its predicted binding to the FimH protein. LyeTx I mnΔK reduced the biomass of few isolates but significantly reduced viability of UPEC cells within biofilms. AMP exhibited negligible cytotoxicity *in vitro* and less toxicity *in vivo*. However, the highest dose of AMP increases the serum creatinine levels and promotes mild tubular degeneration of animal kidney.

Coating of the medical-grade silicon and silicon catheters with AMP-loaded polymers was performed with the use of an ultrasonic deposition method. To assess whether this method can affect AMP activity, preliminary optimization studies were performed with poly (vinyl alcohol) (PVA) as a polymer matrix and poly-L-lysine (PLL) as a model AMP. The results proved that the ultrasonic deposition can be used to form uniform coatings on the surface of silicon without affecting their antimicrobial activity.

Polymer screening tests indicated sodium alginate (SA) as the polymer matrix able to stabilize the activity of AMP. Consequently, an ultrasonic deposition method was used to coat the silicon with LyeTx I mnΔK. Antimicrobial tests revealed that SA/LyeTx I mnΔK coating reduced the bacterial growth and SEM images showed very less bacterial adhesion on the SA/LyeTx I mnΔK. The SA/LyeTx I mnΔK coating showed antimicrobial activity against

catheter-associated pathogens. Additionally, SA/LyeTx I Δ K coating also showed excellent biocompatibility. The SA/LyeTx I Δ K was therefore proven as an efficient way to provide antibacterial effects to urinary catheters.

Keywords: Catheters associated infections; Quinolone-resistant uropathogenic *Escherichia coli*; Antimicrobial peptides; Polymers; Antimicrobial coatings