Development and Optimisation of Novel Amine-based Antimicrobial Cationic Polymers

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With increasing prevalence of antibiotic-resistant microbes, cationic polymers are promising as an alternative antimicrobial system since their mechanism of action aids in preventing development of antibiotic resistance. A low-cost antimicrobial cationic polymer has been developed using a simple one-pot synthesis. Its antimicrobial properties were optimized by varying the number of amine groups in each repeat unit of the polymer. Four different polymers (Polymers A1-A4) were developed and tested for its minimum inhibitory concentration (MIC) against clinically relevant bacteria (E. coli, P. aeruginosa, S. aureus) and fungus (C. albicans) and minimum bactericidal concentration (MBC) against E. coli. Toxicity of polymer against mammalian cells was determined through hemolysis assays using rat red blood cells. A structure-property relationship was then devised between the antimicrobial activity and the number of amine groups in the polymer backbone. It was found that two amine units in the polymer backbone yielded the greatest antibacterial activity while increasing the number of amine units continuously maximizes antifungal activity. Polymer A2 demonstrated the greatest antibacterial activity (MIC: 31.3ppm against E. coli & P. aeruginosa, 62.5ppm against S. aureus. MBC: 62.5ppm against E. coli) while A3 & A4 demonstrated greatest antifungal activity (MIC: 125ppm against C. albicans). Overall, the synthesized polymers displayed high antimicrobial activity at low concentrations and insignificant hemolytic activity, indicating low toxicity to mammalian cells. Further fine-tuning of the polymer's chemical structure could potentially lead to applications in combating drug-resistant bacteria with low hazard to human health.

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