Hydrogel phage formulation for combating *Pseudomonas aeruginosa*

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Abstract

Background: Multidrug-resistant bacterial infections pose a severe public health crisis due to limited antibiotic development, threatening a return to the pre-antibiotic era and incurring substantial human and financial costs. *Pseudomonas aeruginosa*, a challenging multidrug-resistant pathogen, adds complexity with its drug resistance mechanisms and pathogenic factors.

Bacteriophages, viruses targeting bacteria, offer distinct advantages over antibiotics, such as specificity, replication within hosts, and minimal disruption to natural microflora, supporting their efficacy in preventing and treating bacterial infections, particularly in immunocompromised patients. Hydrogels, biomimetic materials, exhibit potential as a stable and controlled delivery system for phages, creating new avenues for combatting antibiotic-resistant infections. This research aims to evaluate the potential of stable phage hydrogel formulation for controlling *Pseudomonas aeruginosa*.

Methods: Bacteriophages were propagated from a phage stock, and hydrogels were prepared with sodium carboxymethyl cellulose in different solutions, followed by rheological analysis. Phage release from hydrogels was assessed qualitatively and quantitatively, and the stability of formulations was evaluated under various storage conditions. Efficacy was determined by testing the product against laboratory and hospital-derived bacterial strains, with absorbance measurements recorded.

Results: The hydrogel-based delivery system inhibited bacterial growth effectively, with laboratory strains reaching a 53.5% inhibition at 5 hours, and clinical strains exhibiting varying levels of inhibition, one sample achieving 68.3% inhibition at 4.5 hours. Notably, the formulated product showed comparable effectiveness to erythromycin gel against laboratory bacteria.

Conclusion: This study signifies progress in utilizing hydrogels for phage delivery to combat antibiotic-resistant infections, providing an alternative therapeutic approach to traditional antibiotics. The study reveals hydrogels' potential as a phage delivery system for combating antibiotic-resistant infections, demonstrating effective inhibition of bacterial growth within an hour of incubation. The rheological analysis indicated the suitability of these formulations for biomedical applications.

Keywords
phage formulation, antimicrobial, hydrogel, Pseudomonas aeruginosa