MICROFLUIDIC SYNTHESIS OF CHITOSAN-TPP NANOPARTICLES FOR DRUG DELIVERY IN ANTIBIOFILM APPLICATIONS

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Biofilms consist of dense bacterial communities embedded in an extracellular polymeric matrix that significantly restricts antibiotic penetration and reduce treatment efficacy [1]. Conventional antibiotic delivery strategies often fail to achieve sufficiently high local drug concentrations, while rapid drug clearance from tissues further limits therapeutic effectiveness [2]. These challenges highlight the need for novel approaches that can improve drug distribution and stability at the site of infection.

This study investigates microfluidic synthesis of chitosan-based nanoparticles, which enables precise control of diffusion and mixing within micrometer-scale channels, allowing more accurate and reproducible nanoparticle formation compared with traditional batch methods.

Tetracycline was incorporated into chitosan–TPP nanoparticles synthesized via ionic gelation, yielding uniform, positively charged particles suitable for interaction with biofilms. The antibiofilm activity of the nanoparticles was evaluated against *Staphylococcus aureus* and *Escherichia coli* biofilms. Encapsulated tetracycline exhibited concentration-dependent inhibition, with stronger suppression of *S. aureus* biofilm metabolic activity compared to the free drug, while *E. coli* biofilms showed higher tolerance. These findings demonstrate the potential of chitosan nanoparticles to modulate antibiotic–biofilm interactions and support their application in antibiofilm drug delivery systems.

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