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Advanced Biosensor Characterization of Phage-Mediated Lysis in Real-Time and under Native Conditions

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Abstract : Due to the spreading of antimicrobial resistance, alternative approaches to combat superinfections are being sought, both in the field of lysing agents and methods for studying bacterial lysis. A suitable alternative to antibiotics is phage therapy and enzybiotics, for which it is also necessary to study the mechanism of their action. Biosensor-based techniques allow rapid detection of pathogens in real time, verification of sensitivity to commonly used antimicrobial agents, and selection of suitable lysis agents. The detection of lysis takes place on the surface of the biosensor with immobilized bacteria, which has the potential to be used to study biofilms. An example of such a biosensor is surface plasmon resonance (SPR), which records the kinetics of bacterial lysis based on a change in the resonance angle. The bacteria are immobilized on the surface of the SPR chip, and the action of phage as the mass loss is monitored after a typical lytic cycle delay. Atomic force microscopy (AFM) is a technique for imaging of samples on the surface. In contrast to electron microscopy, it has the advantage of real-time imaging in the native conditions of the nutrient medium. In our case, Staphylococcus aureus was lysed using the enzyme lysostaphin and phage P68 from the familyPodoviridae at 37 ° C. In addition to visualization, AFM was used to study changes in mechanical properties during lysis, which resulted in a reduction of Young's modulus (E) after disruption of the bacterial wall. Changes in E reflect the stiffness of the bacterium. These advanced methods provide deeper insight into bacterial lysis and can help to fight against bacterial diseases.

Keywords : biosensors, atomic force microscopy, surface plasmon resonance, bacterial lysis, staphylococcus aureus, phage P68

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