

**Onium and alkyl amine decorated protein nanoparticles acts as an inherent antimicrobial agent and carrier of antibiotics to promote synergistic antibacterial and antibiofilm activities**

Anjali Patel, Debasis Manna\*

Centre for the Environment, Indian Institute of Technology Guwahati, Chemistry, Guwahati, Assam, India 781039

dmanna@iitg.ac.in

**Abstract**

The unprecedented cases of antimicrobial resistance and scarcity of effective antibiotics against resistant strains demand the development of proficient drugs and their stewardship. The antibiotics carriers and the adjuvants which can counteract the resistance mechanism and revive the activity of existing antibiotics can be the promising tool to fight against the antimicrobial resistance mechanism. Herein we have reported the antimicrobial activity of the sulfoniumlinked albumin protein, which embraces the benefit of biocompatibility and drug-carrying capability. The scanning electron microscope, transmission electron microscope, and hydrodynamic diameter showed that the modified protein forms the nanoaggregate in the aqueous environment. The sulfonium and lauryl amine conjugated nanoaggregate was utilized to encapsulate the clinically approved antibiotics, and it displayed the release of antibiotics in a controlled manner. Antibiotic encapsulated carrier composite exhibited synergistic antimicrobial activity against Gram-negative and Gram-positive bacterial strains, plummeting the antibiotic's effective dose. Thus, the synthesized antimicrobial carrier molecule revitalizes the activity of the antibiotics and is a cost-effective strategy. Subsequent studies showed that the modified protein was capable enough to breach the biofilm barrier, and at minimum inhibitory concentration, biofilm lost its viability. The antimicrobial activity of the compound was proved to be membrane-directed and had negligible toxicity against erythrocytes and mammalian cell lines.

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**Figure 1.** Schematic representation of the formation of modified BSA-based PNAs and their antibacterial activities