



Designing infection-resistant surfaces: physico-chemical and antibacterial characterization of calcium phosphates/silver nanoparticles composite coatings for titanium implants

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Titanium implants are widely used for their mechanical stability, chemical inertness, and biocompatibility.¹ However, the inertness impairs osseointegration, i.e., the incorporation of an implant into bone, prompting the use of bioactive calcium phosphates (CaPs) coatings. CaPs mimic the main inorganic component of bone² and have therefore been studied and applied for decades in bone implantation. Currently, implant-associated infections are a key problem in treating bone defects with implants. A possible solution to this problem is antibacterial CaP-based coatings containing antimicrobial agents. Silver nanoparticles (AgNPs) are a promising candidate, as silver exhibits a broad spectrum of antibacterial activity and is unlikely to cause bacterial resistance.

CaPs/AgNPs coatings were prepared by wet chemistry method on etched titanium substrates. Etching with a mixture of sulphuric and hydrochloric acids followed the method described by Lu et.al.³ AFM, SEM, and contact angle measurements showed increased surface roughness, altered surface topography, and wettability due to etching, all of which favour osteoblast cell adhesion, as reported in previous studies. Furthermore, SEM and optical profilometry showed more uniform coating distribution on the etched titanium surface compared to the unetched surface.

Antibacterial efficacy was assessed using indirect (crystal violet staining) and direct (CFU counting) methods and visualised by SEM. Both demonstrated reduced biofilm formation by *Staphylococcus aureus* and *Escherichia coli* on CaPs/AgNPs-coated titanium compared to uncoated titanium.

The obtained results indicate that functional, antimicrobial coatings can be prepared through the simple wet method, which could contribute to further development of affordable antibacterial implant materials.

Keywords: antibacterial activity; calcium phosphates; silver nanoparticles; surface modification; titanium implants

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References:

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