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Synthesis, Characterization and Antimicrobial Activity of Garcinol Coated Titanium Dioxide Nanoparticles

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Background: Garcinol is a secondary metabolite derived from the plants of Clusiaceae Family. It has shown a broad range of bioactivities such as antimicrobial, antioxidant, anticancer and anti-inflammatory. Titanium dioxide nanoparticles (TiO₂NPs) are known to have a significant photocatalytic activity and are widely used in medicine. In this study, garcinol was used to modify the surface of TiO₂NPs to enhance the antibacterial activity.

Objectives: To synthesize, characterize and determine antimicrobial activity of garcinol coated titanium dioxide nanoparticles G-TiO₂NPs.

Methods: Garcinol was isolated from the dried fruit rinds of *Garcinia quaesita*. TiO₂NPs were coated by garcinol and characterized by using Scanning Electron Microscopy (SEM), Powder X-Ray Diffraction (XRD), and Diffused Reflectance Spectroscopy. Minimum Inhibition Concentration (MIC) was tested against five microbial species including *Staphylococcus aureus* (ATCC 25623), *Pseudomonas aeruginosa* (ATCC 27853),

Escherichia coli (ATCC 25922), *Candida albicans* (ATCC 10231) and clinical isolates of Methicillin Resistant *Staphylococcus aureus* (MRSA), using broth micro-dilution assay. Time-kill kinetic study was performed to determine the inhibition percentage of *Staphylococcus aureus* over time.

Results: SEM images confirmed the spherical shape of G-TiO₂NPs, diameter ranging from 20 - 200 nm. XRD data revealed the anatase phase and rutile phase of TiO₂NPs. Formation of G-TiO₂NPs caused a red shift of the absorption wavelength. G-TiO₂NPs and TiO₂NPs showed a MIC range of 250-500 µg/ml and 500-1000 µg/ml against the tested microbial species, respectively. In the time-kill kinetic studies, inhibition percentage (IP) of microbial growth was determined at 60 minute time intervals. TiO₂NPs and G-TiO₂NPs demonstrated inhibition over 50% at 3 hours.

Conclusions: G-TiO₂NPs presented a significant enhancement in antimicrobial activity against *S. aureus* compared to TiO₂NPs. Surface modification of TiO₂NPs with garcinol has created a synergistic antimicrobial effect against *S. aureus*.

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