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EXPLORING EFFICACY OF GOLD NEAR INFRARED DYE CONJUGATED CALCIUM CARBONATE NANOPARTICLES DERIVED FROM COCKLE SHELL FOR POTENTIAL MOLECULAR IMAGING

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THESIS ABSTRACT

The development of biocompatible and economical bio nanomaterial for molecular imaging modalities rapidly increases, with aim of enhancing and improving detection. Ultimately, providing information at a molecular and cellular level. This is a promising, long term non-toxic and biocompatible approach for decreasing mortalities, and advancement to molecular imaging. Presently, the molecular imaging modalities such as the Computed Tomography (CT) and optical modalities suffer limitations like poor specificity, low sensitivity and poor signal penetration through tissues. Additionally, the current imaging agents used for molecular imaging are known to be associated with non-biodegradability or slow excretion and high toxicity, challenging the production of a strong imaging signal However, the complexity of cellular and molecular processes of any biological system pose a challenge for the development of novel nanomaterial like the conjugated near infrared gold cockle shell-derived calcium carbonate nanoparticles (Au-$CsCaCO_3$NPs). Thus, biocompatibility assessment and proof of cellular uptake is essential to further biomedical applications. This research developed and characterized Au-$CsCaCO_3$NPs derived from cockle shell calcium carbonate nanoparticles ($CsCaCO_3$NPs) and gold nanoparticles (AuNPs).

The obtained spherical shaped nanoparticles diameter size 35 nm ± 11, were characterised using Transmission Electron Microscope (TEM), Field Emission Scanning Electron Microscope (FESEM) equipped with Energy Dispersive X-ray (EDX) for their physicochemical properties and elemental analysis. Fourier transform infrared spectroscopy (FTIR) revealed significant supporting interactions between the conjugated nanoparticles, Zetasizer highlighted the stability with the highly negative nanoparticles charges and Uv-Vis spectrophotometer displayed significant synthetic regions of the nanoparticles. For biocompatibility assessment and cellular uptake imaging; the studies were done on breast cancer cell line (MCF-7) against mouse fibroblast normal cell line (NIH3T3). This was done using 3-Dimethylthiazo-2,5-diphynyltetrazolium bromide (MTT), lactate Dehydrogenase (LDH), Reactive Oxygen Species (ROS) assays and fluorescent confocal imaging which confirmed nontoxic on normal cells and evidence of cellular interactions. Furthermore, IC_{50} was noted 23 – 25 µg/ml for the conjugated nanomaterial. The threshold of significance was $p < 0.05$. Based on the results, Au-$CsCaCO_3$NPs were most biocompatible and proved to be excellent potential candidate for enhancing molecular cancer imaging and other biomedical applications.