Title: Encapsulation of the Anticancer Drug Cisplatin in Titanium dioxide Nanoparticles for Targeted Drug Delivery and Slow Release.

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Abstract:

In the recent past, much progress has been seen in the use of nanoparticles for efficient drug delivery, so as to cause minimum damage towards the internal organs and healthy cells while targeting the drug to the appropriate body part. For this research, titanium dioxide (TiO_2) nanoparticles have been considered for the targeted drug delivery, due to the presence of large amounts of Ilmenite ($FeO.TiO_2$) reserves in Pulmuddai, Sri Lanka. Moreover, this research has been motivated by the biocompatibility, stability under a large pH range, ability to enhance bone bonding and good photocatalytic properties of titanium dioxide. The nanoparticles can be combined with pH selective or even MRI active functionalities to monitor and target them towards the tumor cells. Metal based anticancer drugs play a major role in chemotherapy. The anticancer drug cisplatin, $Pt(NH_3)_2Cl_2$, has been used to incorporate into the porous nanoparticles. In DNA bending, cisplatin losses its Cl- ligands in exchange of the N atoms in Adenine and Guanine, which then inhibits the cell division process. Cisplatin bonds tightly with the N centers as they balance the charge more effectively. In this study, the nano-porous TiO_2 was synthesized using several methods, such as using zinc oxide or micelles to create the pores. However, the most efficient method was by the hydrolysis of titanium tetraisopropoxide (TTIP), in the presence of the polysaccharide, agar, to induce the porosity. The temperature, at which the agar incorporated TiO_2 nanoparticles are calcines at, was carefully determined so as to not change the phase from anatase to rutile. The cationic, biocompatible surfactant cetyltrimethyl ammonium tosylate (CTAT) has been used to prevent the agglomeration of the nanoparticle and to stabilize them in the solvent. The anticancer drug was encapsulated, by a physisorbtion mechanism, where the drug was allowed to physisorb on to the nano-porous TiO_2. Determination of the encapsulation efficiency and the release kinetics were done with the aid of Atomic Emission Spectrascopy (AES). The drug release kinetics were studied under thermostatic conditions (37˚C). the investigation of the elemental composition, crystallinity and morphology was done using X-ray Florescence (XRF), X-ray diffraction (XRD) Fourier Transform Infrared (FT-IR). Scanning Electron Microscopy (SEM) images were obtained for the nano-porous TiO_2 nanoparticles and the encapsulated products. For more accurate elemental composition data, Energy Dispersive X-ray spectroscopy (EDX) was used. The SEM images obtained determined that the nanoparticles were spherical in shape and the particle size analysis gave an average particle size of (94.3±0.1) nm. The XRD data suggested that the TiO_2 was in the anatase form as expected. The XRF, EDX, FT-IR studies revealed the presence of the anticancer drug, cisplatin, in the TiO_2 nanoparticles. Furthermore, the AES data obtained, showed that the encapsulation efficiency of the drug is 80.4%. However, the release kinetics suggested minute release percentages, even after 24 hours, irrespective of the pH of the medium. Therefore, the incorporation of the anticancer drug, cisplatin, in to TiO_2 nanoparticles may not be applicable to release the drug selectively under acidic conditions of the cancer cells.

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Biography:

Liyanage P.L.J.B. has completed her BSc. Degree in Chemistry honors, from the University of Peradeniya, Sri Lanka and is currently employing as a demonstrator in the Department of Chemistry, University of Peradeniya, while seeking for graduate admission.

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