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Electrostatic interaction mediated encapsulation of gold nanoparticles in liposomes for targeted drug delivery

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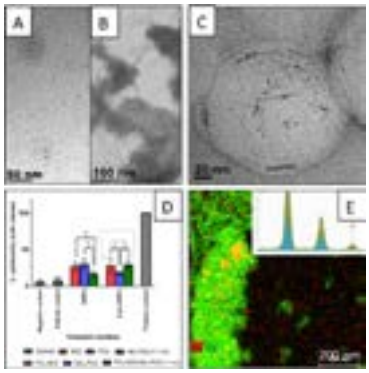
Self-assembling nanomaterials (SANs) promise technological innovation at all stages of healthcare, encompassing fields of genomics, biosensorics, immunoanalysis, drug delivery, detection, monitoring and treatment of diseases and infections. The generalized aim across these disciplines can be described as working towards the design of "smart" multifunctional nanosystems that interact, respond and provide treatment. Molecular recognition and electrostatic attraction are two different strategies of gold nanoparticle self-assembly. Therefore, in order to exploit this effect, the development of liposome-nanoparticle colloid systems offers a versatile approach towards the manufacture of multifunctional therapeutic platforms. Small metallic nanoparticles were encapsulated within multilamellar vesicles by exploiting electrostatic interactions. Liposome-gold nanoparticle (lipo-GNP) systems with opposite charges, positively charged gold with negatively charged lipids (NCL-PCG) and negatively charged gold with positively charged lipids (PCL-NCG) were prepared by the reverse-phase evaporation method. The lipids were subjected to post-formulation PEGylation. The liposome-nanoparticle systems were characterized using scanning electron microscopy (SEM) and elemental analysis using atomic emission spectroscopy (AES). The observations revealed a regular distribution of GNPs (gold nano particles) between adjacent lipid bilayers of intact liposomes. Nanoparticle encapsulation efficacy of the two lipo-GNP systems was revealed to be significantly different, evaluated by comparing the ratio of measured lipid to gold concentration. These observations confirmed that the developed synthetic strategy is an effective approach for the preparation of liposome-nanoparticle colloids with potential to control the relative concentration of encapsulated particles to lipids by providing favorable electrostatic interactions. Toxicity evaluation for NCL-PCG and PCL-NCG was performed *in vitro* on hamster lung fibroblasts (V79), employing MTT and LDH assays. Cellular uptake of nanoparticles was investigated using a combination of electron microscopy and elemental analysis. PCG and NCG did not display cytotoxicity while PCL-NCG and NCL-PCG along with PCL and NCL exhibited significant dose-dependent cytotoxicity. Cellular internalization of gold nanoparticles was evidenced within cellular vacuoles.



Recent Publications

1. Dichello G A, Fukuda T, Maekawa T, Whitby R L D, Mikalovsky S V et al. (2017) Preparation of liposomes containing small gold nanoparticles using electrostatic interactions. European Journal of Pharmaceutical Sciences. 105:55-63.

2. Sazhin S, Rybdylova O, Pannala A S, Somavarapu S, Zaripov S K (2018) A new model for a drying droplet. International Journal of Heat and Mass Transfer. 122:451-458.