PROBING THE DIFFUSION OF FUNCTIONALISED NANOPARTICLES IN GASTRIC MUCIN USING NANOPARTICLE TRACKING ANALYSIS

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Abstract

With the increased use of nanoparticles in the pharmaceutical, cosmetic and food industries, there is a need to understand how these particles behave in biological fluids in order to predict their in vivo activities. Mucus for example, coats tissue surfaces throughout the gastrointestinal tract, and acts as a barrier to drug delivery. Here we present research on the diffusion of organosilica nanoparticles functionalised with two polymers, poly(ethylene glycol) (PEG), and poly(N-isopropylacrylamide) (pNIPAM), through porcine gastric mucus using Nanoparticle Tracking Analysis (NTA). Much of the current research on diffusion through mucus focusses on particles functionalised with PEG as this addition enhances the rate of diffusion via hydrogen bonding.By using fluorescently labelled thiolated silica as a model, we have developed a series of nanoparticles functionalised with PEG and pNIPAM. Nanoparticles were characterised for size and surface functionality with a variety of techniques including SANS, DLS, and TGA. The diffusion of functionalised nanoparticles suspended in mucin was studied using NTA, and the results were compared with the theoretical estimation of diffusion coefficients using the Stokes-Einstein equation. By fluorescently labelling the particles it is possible to monitor their diffusion without interference from mucin. Preliminary experimental work suggests that PEGylated particles diffuse in mucin more readily than thiolated ones, which is in agreement with the literature (1). pNIPAM also demonstrates this ability, however further work needs to be carried out in order to fully understand the thermosensitive natures of the particle/polymer combination.

Keywords: Nanoparticles, Diffusion, Nanoparticle Tracking Analysis, Drug delivery

LITERATURE

[1] Lai, S.K.,et al., 2009. Advanced Drug Delivery Reviews, 61(2), pp. 158-171

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