EXPLOITING NANOSCALE MATERIALS PROPERTIES FOR CONTROLLED DRUG DELIVERY SYSTEMS

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DECLARATION

I declare that the work contained in this thesis submitted by me for the degree of Doctor of Philosophy is my work, except where due reference is made to other authors, and has not been previously submitted by me for a degree at this or any other university.

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Abstract

The main objective of this work was to develop a novel drug delivery system exploiting special opportunities afforded by synthesis of nanoscale materials to be applied inside the colon. It must be robust enough to cope with the adverse conditions in the gastrointestinal tract (GI) and be able to reach and release "on demand" at the colon area at the right time. In this work, an oral capsule formulation with iron oxide nanoparticles (IONs) containing coating was used to transport drug and release drug in the colon.

With that in mind, the synthesis of poly (alkylcyanoacrylate) nanocapsules by microemulsion polymerisation and magnetic iron oxide nanoparticles (IONs) via a co-precipitation method were conducted. The key physical properties of the materials were characterized employing standard techniques such as HPLC, FTIR, DSC, DLS, XRD, TEM and SEM. Hard capsules filled with model drug, paracetamol, were coated with IONs containing coatings (fatty acids and paraffin). The optimum composition for the formulation of the coating embedded with the nanoparticles was explored with respect to protection of the drug payload from conditions in the GI tract as well as for effective release "on demand" using radio-frequency hyperthermia. The optimum radiofrequency and the power level for heating the nanoparticles were also determined and melting the coating using magnetic nanoparticle hyperthermia.

Results showed that paraffin-based coatings had appropriate properties for this application. Finally, taking into account all the results, a design of a novel drug delivery system, together with an experimental setup for testing the "release in demand" was proposed. The approach is generic, easy to set up and could also be applied to many other situations where delivery on demand is required.