Porous biopolymer microspheres for targeted drug delivery and release of biological components

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There is an increasing clinical need to develop systems for targeted delivery and release of drugs and other biological components, as potential alternate cancer treatments for example. With regards to cancer treatment, the majority of treatments are systemic using typically highly toxic drugs which can also damage normal healthy cells and can in fact induce cancer. Many drug delivery systems have been devised to address this issue; however these entail their own problems. As an example, antineoplastic drugs (which act to reduce the spread of tumours) are typically low-molecular-weight (<500 Da) hydrophobic compounds and are consequently difficult to administer systematically (i.e. intravenously) due to their poor solubility and clearance by the renal system. Furthermore, these drugs have little specificity towards the target with multiple side-effects and significant systemic toxicity issues are common.

There is currently considerable interest in novel drug delivery systems for enhancing therapeutic efficacy and minimising systemic side effects. Therapeutics can be incorporated either as dissolved or dispersed phases into polymeric matrices which degrade or resorb in contact with biological fluids or other stimuli, allowing for progressive release of the payload drug. Recently, much research has been focused on biodegradable polymer microspheres for localised drug delivery. However, the release from such systems usually occurs via a 'burst release' mechanism, which is undesirable for most treatments as a more controlled release of payload over time is preferred.

The innovation for the microsphere technology proposed is as follows; (1) the degradation profiles for the polymers can be tailored to the specific end application, (2) these microspheres can easily be loaded with drugs and biological components for treatment of various disease conditions, (3) microspheres can provide a minimally invasive delivery route through mechanisms such as syringes for delivery.

Such systems offer many advantages over traditional methods of administration such as: i) Drug or biological component use rates can be tailored to the needs of a specific patient or application; ii) These systems can provide protection for the biological components incorporated (especially for drugs and proteins that would otherwise be rapidly destroyed by the body; and iii) Can increase patient comfort and compliance by replacing frequent (e.g. daily) doses with infrequent (once per month or less) injections.

This project will aim to develop novel porous microsphere substrates, investigate scale-up manufacture and determine the pay load release profiles. The objectives will in include:

1) Manufacture of uniform geometry and size ranges of microspheres from varying biopolymers
2) Design and produce the systems for scale-up manufacture of these microspheres
3) Ascertain the most suitable drug and biological components to be incorporated and released
4) Functionalise the microspheres produced based on specific end application envisaged

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