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Abstract

Novel Drug and Nutraceutical Delivery System for the Treatment of Inflammatory Bowel Disease †

Aoife Murtagh *, Clement Higginbotham and Patricia Heavey

SHE (Sport, Health, and Exercise) Nutrition Research Group, Technological University of the Shannon: Midlands, N37 HD68 Athlone, Ireland; clem.higginbotham@tus.ie (C.H.); patricia.heavey@tus.ie (P.H.)

* Correspondence: a.murtagh@research.ait.ie

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Abstract: Background and objectives: Inflammatory bowel disease is a chronic condition with no cure. However, there are a range of treatment options. Pharmacological approaches are usually the first step in treatment, and they are effective for many patients; however, for some, side effects are evident, and effectiveness can reduce overtime. Research on advanced delivery systems, new drugs and the therapeutic benefits of nutraceuticals such as curcumin have been previously investigated with promising results for IBD treatment, although they present their own unique challenges including poor bioavailability. The poor bioavailability of hydrophobic agents including curcumin is partly attributed to poor solubility and inadequate concentrations at target tissues. Therefore, the aim of the present work was to develop a novel pH-sensitive drug and nutraceutical delivery system featuring microspheres embedded in a hydrogel. Methods: Polylactic acid–polyethylene glycol microspheres loaded with dexamethasone (0.8 wt%) and curcumin (0.8 wt%) were synthesised using an emulsion solvent evaporation method. pH-sensitive polyethylene glycol dimethacrylate-co-acrylic acid hydrogels (46.6% and 33.3%, respectively) were synthesised with water (20%) by UV-photopolymerisation. The dexamethasone and curcumin microspheres were embedded into the hydrogels. Hydrogels and microspheres were characterised separately to understand their properties. Results: The encapsulation efficiency of the dexamethasone and curcumin microspheres was promising with higher encapsulation efficiency achieved for the curcumin microspheres (29% and 92%, respectively). Swelling studies demonstrated the equilibrium water content (EWC), the ability of the hydrogel to uptake its surrounding solution, with differences observed in response to changes in pH. In pH 6.8, hydrogels took up more of the surrounding solution compared to pH 2.2 (EWC% after 24 h = 69% and 56%, respectively). Gel fraction studies showed that the efficiency of the network formed during photopolymerisation (96%). Discussion: This targeted drug and nutraceutical delivery system may have the potential to play a role for IBD treatment with the combined impact of the microspheres in the hydrogel to be established. Dexamethasone and curcumin were encapsulated into microspheres which aid their solubility. The hydrogel component may help achieve a targeted delivery system, owing to the changes observed in response to different pH levels, as would be observed along the gastrointestinal tract.

Keywords: inflammatory bowel disease; delivery system; pharmacology; nutraceuticals; microspheres; hydrogels; treatment; management

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