Polymeric Lids for Microcontainers for Oral Protein Delivery

Oral delivery of proteins and peptides is one of the main challenges in pharmaceutical drug development. Microdevices have the possibility to protect the therapeutics until release is desired, avoiding losses by degradation. One type of microdevice is polymeric microcontainers. In this study, lysozyme is chosen as model protein and loaded into microcontainers with the permeation enhancer sodium decanoate (C10). The loaded microcontainers are sealed and functionalized by applying polymeric lids onto the cavity of the devices. The first lid is poly(lactic-co-glycolic) acid (PLGA) and on top of this either polyethylene glycol (PEG) or chitosan is applied (PLGA+PEG or PLGA+chitosan, respectively). The functionalization is evaluated in vitro for morphology, drug release, and mucoadhesive properties. These are coupled with in vitro and ex vivo studies using Caco-2 cells, Caco-2/HT29-MTX-E12 co-cultures, and porcine intestinal tissue. PLGA+chitosan shows slower release compared to PLGA+PEG or only PLGA in buffer and the transport of lysozyme across cell cultures is not enhanced compared to the bulk powder. Microcontainers coated with chitosan or PEG demonstrate a three times stronger adhesion during ex vivo mucoadhesion studies compared to samples without coatings. Altogether, functionalized microcontainers with mucoadhesive properties and tunable release for oral protein delivery are developed and characterized.