Oral delivery of iGal3BP via pH-responsive GO@APC hydrogel fiber for blood pressure control

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Abstract
Compared with intravenous administration, oral delivery is widely regarded as a convenient and noninvasive route for drug administration. However, for protein- and peptide-based therapeutics, oral bioavailability remains limited due to their large molecular size and the harsh gastrointestinal environment. In this study, we integrated natural polyelectrolytes with graphene oxide (GO) to fabricate hybrid hydrogel fibers featuring a bead-on-string architecture for oral peptide delivery. Microspherical domains are formed within the bead regions of the fibers, where peptide therapeutics are preferentially localized. This unique structural design enables nearly 100% encapsulation efficiency of the peptides. Furthermore, the incorporation of GO introduces additional adsorption sites and facilitates a more controlled and sustained release profile. As a result, the system exhibits pH-responsive, intestine-targeted release behavior, with only 9.4% peptide release in simulated gastric fluid (SGF) and 75.6% release in simulated intestinal fluid (SIF) for the GO@APC hydrogel fibers. In vivo mouse oral gavage experiments demonstrated that the peptide-loaded fibers effectively reduced blood pressure, confirming the biological functionality of the released peptide.