ABSTRACT

Diabetes mellitus represents a global health challenge that necessitates life-long therapy and proper glycemic regulation. Although subcutaneous injections are the traditional method of insulin administration, they are invasive, inconvenient, and often result in poor patient compliance. Therefore, oral insulin delivery offers a patient-friendly and non-invasive alternative to subcutaneous injections. Nevertheless, its clinical application is hampered by enzyme degradation, low intestinal absorption, and bioavailability. Liposomes, typically used drug carriers, tend to protect insulin and enhance intestinal absorption but are accompanied by destabilization in acidic environment, subsequently, compromises on the sustained delivery. In contrast, hydrogel offers pH-responsive and sustained release with mucosal adhesion but its porous structure leads to early burst. To address these shortcomings, insulin loaded liposomes were entrapped in a hydrogel matrix of gum tragacanth and sericin. The liposome-hydrogel complex (INS-LIP-GEL) effectively prevented gastric degradation and promoted intestinal retention, while in vivo evaluation confirmed controlled insulin release with pronounced hypoglycemic efficacy. In addition, in vivo assessments in diabetic mice determined significant and enduring hypoglycemic impacts, which indicate better therapeutic behavior. Collectively, the INS-LIP-GEL system establishes an integrated nanoscale platform with protective, mucoadhesive, and sustained-release attributes, representing a promising strategy to advance oral insulin therapy. The developed composite system offers a practical and patient-friendly oral insulin delivery approach with strong potential to improve therapeutic efficacy and diabetes management.

Keywords: Diabetes management, oral insulin delivery, patient compliance, Gum Tragacanth, bioavailability, hypoglycemic effect, controlled release, intestinal absorption