

Development of sustained-release hydrogel beads of aspirin

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Aspirin, also known as acetylsalicylic acid (ASA), is a nonsteroidal anti-inflammatory drug (NSAID) with analgesic, antipyretic, anti-inflammatory, and antiplatelet properties, has a short half-life of 15–20 minutes, plasma concentration fluctuations and gastrointestinal adverse effects. Hence, this study aimed to develop and optimize chitosan-coated pectin hydrogel beads for oral sustained-release of aspirin. The pectin beads were prepared by ionotropic gelation method. Optimization was carried out by varying pectin concentration (4%, 5%, 6% w/v), CaCl_2 concentration (2% and 5% w/v) and curing time (20 and 60 minutes). The optimal conditions were determined as 5% pectin, 5% CaCl_2 and 60 minutes of curing time, which yielded the highest EE% of $74.99\% \pm 0.09$ and LC% of $10.05\% \pm 0.01$. The optimal formulation (F8) was coated with different chitosan concentrations (0.2%, 0.1%, and 0.05%). The 0.05% chitosan concentration was selected as optimal, achieving an 8-hour release profile, with a coating thickness of $11.5 \pm 1.0 \mu\text{m}$, in contrast to 15 hours and more than 24 hours for the 0.1% and 0.2% concentrations, respectively. FTIR results confirmed

the successful loading of the drug and the formation of the polyelectrolyte complex by the peak shifts in the C=O and COO- stretching bands. Furthermore, the SEM images confirmed the successful coating by the presence of a distinct layer with surface roughness, ridges and protrusions on the coated beads, unlike the smooth and spherical shape of the uncoated beads. *In vitro* release studies in individual buffers showed that F8 released aspirin rapidly (70% at pH 1.2 in 4 hours; 74% at pH 6.8 in 3 hours) than F15 (70% at pH 1.2 in 6 hours; 81% at pH 6.8 in 6 hours). Sequential release achieved 100% for F15 in 8 hrs whereas F8 achieved 93% in 5 hrs. Both followed Korsmeyer-Peppas model with super case II in sequential studies and Fickian diffusion in individual buffers, confirming sustained aspirin release with reduced gastrointestinal irritation and improved patient compliance.

Keywords:

Aspirin; pectin hydrogel beads; chitosan coating; sustained-release; ionotropic gelation.