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Synthesis of Chitosan/Alginate Nanoparticles from the Aqueous extract of *Asparagus falcatus* L. with enhanced anti-inflammatory activity

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Nanoparticle systems integrating alginate and chitosan emerge as a promising platform for anti-inflammatory therapeutics. *Asparagus falcatus* L. (Family: Asparagaceae) is a medicinal plant recognized for its potent anti-inflammatory activity based on previous scientific studies. This study aimed to synthesize, characterize, and assess the anti-inflammatory activity of aqueous extract of *A. falcatus*-loaded alginate/chitosan nanoparticles. Aqueous extract of *A. falcatus* (0.125 mg/mL) loaded alginate/chitosan nanoparticles were prepared by ionotropic pregelation of an alginate followed by chitosan polyelectrolyte complexation. Characterization of *A. falcatus*-loaded alginate/chitosan nanoparticles was performed in terms of particle size, zeta potential, polydispersity index, scanning electron microscopy (SEM), and Fourier transform Infrared spectroscopy (FTIR). Anti-inflammatory activity was evaluated in terms of xanthine oxidase, hyaluronidase inhibitory, and membrane stabilization assays. Allopurinol, tannic acid, and diclofenac were used as their positive controls, respectively. The *A. falcatus*-loaded alginate/chitosan nanoparticles had maximum encapsulation efficiency and loading capacity at 3 mg/mL concentration of 82.42% and 0.37%, respectively. The polydispersity index and zeta potential of A. falcatus-loaded alginate/chitosan nanoparticles were 0.44 and -19.4 mV, respectively indicating the broad size distribution of particles and a lesser tendency to aggregate. SEM and FTIR confirmed that particles were in an acceptable nano range and successful encapsulation of A. falcatus into the alginate/chitosan matrix. The *A. falcatus*-loaded alginate/chitosan nanoparticles were active against xanthine oxidase inhibition, with significant ($p<0.05$) improvement of 53.74% compared to its crude extract and positive controls. The aqueous extract of *A. falcatus*-loaded alginate/chitosan nanoparticles was capable of inhibiting hyaluronidase enzyme and hypotonicity-induced hemolysis under membrane stabilization at 8.93% and 48.37%, significant improvement respectively. In conclusion, *A. falcatus*-loaded alginate/chitosan nanoparticles showed enhanced anti-inflammatory activity, highlighting their potential as promising nanotherapeutics.

Keywords: Asparagus falcatus, Chitosan, Alginate, Nanoparticles, Anti-inflammatory