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Chitosan-based nanogel of *Opuntia elatior* Mill.: Molecular docking, anti inflammatory, and wound healing efficacy

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The existing study investigates the formulation and evaluation of a chitosan-based nanogel containing *Opuntia elatior* Mill. extract, aimed at enhancing anti-inflammatory and wound healing efficacy through both *in vitro* and *in silico* approaches. *O. elatior*, a xerophytic plant widely used in traditional medicine, is rich in bioactive compounds known for their therapeutic potential. Ionic gelation was used to incorporate the extract obtained by maceration into chitosan nanoparticles. These nanoparticles were further formulated into a nanogel using Carbopol 934. Dynamic light scattering (DLS) analysis of the produced nanogel showed a Z-average particle size of 89.34 nm, a polydispersity index (PDI) of 0.416, and a zeta potential of +14.1 mV, showing good stability and dispersibility. Characterisation techniques, including FTIR, SEM, DSC-TGA, and XRD, confirmed the presence and successful incorporation of the extract within the gel matrix. Protein denaturation and trypsin inhibition tests were used to assess the nanogel's *in vitro* anti-inflammatory activity, and the results showed it was either as effective as or more effective than diclofenac sodium. Wound-healing efficacy was evaluated using a scratch assay with L929 fibroblast cells, in which the nanogel promoted significant cell migration and wound closure. Furthermore, molecular docking studies showed strong binding affinities of key phytoconstituents, particularly isoquercetin, with TNF-alpha protein (PDB ID: 2AZ5), suggesting potential anti-inflammatory mechanisms. These results collectively indicate that the chitosan-based nanogel from *O. elatior* is a promising candidate for topical application to manage inflammation and promote wound healing, thereby validating its traditional medicinal use.

Keywords: Ligand, Maceration, Nanogel, *Opuntia elatior* Mill., Thermal analysis

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