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Fabrication and characterization of chitosan–gelatin–chondroitin sulfate-diclofenac scaffold with cross-linked glutaraldehyde for potential application in osteoarthritis

Journal of Applied Pharmaceutical Science • Article • *Open Access* • 2025 •
DOI: 10.7324/JAPS.2025.v15.i12.8

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Abstract

The inadequate regenerative capacity of cartilage renders osteoarthritis (OA) and cartilage injuries difficult to manage. In tissue engineering, a scaffold facilitates establishing an environment favorable to cell proliferation, migration, and adhesion. Moreover, diclofenac sodium can be administered locally due to the scaffold's porous architecture, which possesses anti-inflammatory characteristics. This study investigated the development and characterization of an innovative scaffold formulation intended for potential application in cartilage repair associated with OA and cartilage injuries. The scaffold was cross-linked with varying concentrations of GA (0.00%–2.50%) and comprised chitosan, gelatin, chondroitin sulfate, and PEG 400. The scaffold also contained the anti-inflammatory agent, diclofenac sodium, which was dissolved in PEG 400 for targeted drug delivery. The

pore diameter, porosity, compressive strength, and degradation of the scaffolds were assessed following their dried form. The results indicated that GA significantly influenced these attributes, with porosity, mechanical stability, and degradation control improved at an optimal concentration of 0.50 percent. GA cross-linking between polymer chains enhanced the scaffold's integrity and augmented its mechanical properties through the establishment of more rigid structures. The cross-linking of the amino group in chitosan with the sulfonate group in chondroitin sulfate enhanced the scaffold's stability. The study's findings indicated that GA-optimized chitosan–gelatin–chondroitin sulfate-PEG 400-diclofenac scaffolds exhibited suitable physicochemical and mechanical properties, supporting their potential use in localized drug delivery systems for OA management. © 2025 Wa Ode Nurfinti et al.

Author keywords

Cartilage; GA; medicine; neglected tropical disease; osteoarthritis

Indexed keywords

EMTREE drug terms

antiinflammatory agent; chitosan; chondroitin sulfate; diclofenac; gelatin; glutaraldehyde; macrogol 400

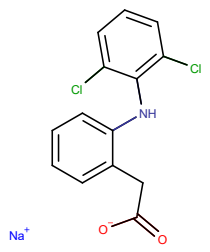
EMTREE medical terms

antiinflammatory activity; Article; cartilage injury; cell adhesion; cell migration; cell proliferation; cell viability; chondrocyte; cytotoxicity; drug delivery system; extracellular matrix; freeze drying; human; human cell; MTT assay; osteoarthritis; particle size; pH; pore size distribution; tissue engineering

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Chemicals and CAS Registry Numbers

Unique identifiers assigned by the Chemical Abstracts Service (CAS) to ensure accurate identification and tracking of chemicals across scientific literature.

chitosan	9012-76-4
chondroitin sulfate	9007-28-7, 9082-07-9
diclofenac	15307-79-6, 15307-86-5
gelatin	9000-70-8
glutaraldehyde	111-30-8, 37245-61-7

Funding details

Details about financial support for research, including funding sources and grant numbers as provided in academic publications.

Funding sponsor	Funding number	Acronym
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Funding text

This research was funded by Universitas Airlangga under Penelitian Dasar Unggulan Universitas Airlangga through research scheme No. 943/UN3.FF/PT.01.03/2024.

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