

Fabrication of Dermal Patch for Wound Care with Graphene Oxide Based Nanocomposites Loaded with Gallic Acid

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Abstract

Graphene-based nanocomposites have been used as a promising drug delivery mechanism due to their significant properties. Gallic Acid (GA) is a natural bioactive compound with pharmacological properties including anti-bacterial, anti-inflammatory, and antioxidant activity. The objective of the present study was to form a dermal patch loaded GA to facilitate wound healing. Initially, nano-graphene oxide was synthesized using Hummer's method followed by PEGylation. Then GA was loaded with 1:1 ratio and by which characterization studies were conducted to confirm the successfulness of the formulation procedure. Anti-inflammatory and antioxidant activities of the nanocomposite were evaluated by Egg albumin method. The dermal patch was fabricated using the solvent evaporation technique followed by characterisation studies. The SEM (scanning electron microscope) confirmed the physical existence of GA on the matrix with particle size varying from 200 to 450nm. The FTIR (Fourier-Transform Infrared spectroscopy) exhibited the structural arrangement of the nanocomposite. Thermogravimetric analysis (TGA) proved the thermal endurance with breakdown of the aromatic structure occurred in between 210 to 600°C. The Particle Size Analysis (PSA) confirmed that the average particle size distribution lies between 193.48nm and 246.98nm. The antioxidant activity of the nanocomposite was revealed with an IC₅₀ value of 3.78 mg/mL for ABTS assay, 4.15 mg/mL for FRAP assay, and 3.50 mg/mL for NO assay. The antioxidant assay was conducted using Ascorbic acid as the positive control. The nanocomposite exerted an anti-inflammatory activity with an IC₅₀ value of 11.39 mg/mL. Here Diclofenac Sodium was used as the positive control. Finally dermal patch was developed. The formulation consisted with Polyvinylpyrrolidone: Hydroxypropyl Methyl Cellulose, 2:8 was selected as the best formulation with the suitable characteristics which can lead to the formulation of successful wound healing application.

Keywords: *Gallic acid, Graphene oxide, Dermal patch*