❖ Abstract:

Skin infections caused by bacterial pathogens represent a significant healthcare burden due to increasing antibiotic resistance and limited efficacy of conventional treatments. In recent years, the development of novel drug delivery systems utilizing natural polymers and phytochemicals has gained considerable attention. This study focuses on the formulation and evaluation of a hydrogel incorporating curcumin and guar gum, aiming to harness their synergistic antimicrobial and wound-healing properties for the effective treatment of bacteria-infected skin infections. Curcumin, a hydrophobic polyphenol derived from Curcuma longa, is renowned for its broad-spectrum antimicrobial, anti-inflammatory, and antioxidant properties. However, its clinical application is restricted by low aqueous solubility and poor bioavailability. Guar gum, a natural polysaccharide with excellent gel-forming ability, biocompatibility, and biodegradability, serves as an ideal hydrogel base to enhance curcumin's stability and facilitate controlled drug release at the infection site. The hydrogel was formulated using a solvent evaporation technique, followed by physicochemical characterization involving pH, spreadability, viscosity, swelling index, and drug content uniformity. In vitro drug release studies were conducted using a dialysis membrane, while the antimicrobial efficacy was assessed against common bacterial strains (*Pseudomonas aeruginosa, Escherichia coli, Bacillus subtilis, Bacillus cereus, Aspergillus niger* and *Candida albicans*) using agar well diffusion. The hydrogel was also evaluated for its skin compatibility through dermal irritation tests on animal models. Results demonstrated that the curcumin-guar gum hydrogel exhibited favourable physicochemical properties, sustained drug release, and significant antibacterial activity. The hydrogel was non-irritant and showed promising potential in reducing bacterial load and enhancing wound healing. In conclusion, the curcumin and guar gum-based hydrogel represents a promising, natural, and cost-effective topical therapeutic strategy for managing bacterial skin infections, particularly in the context of rising antibiotic resistance. Further in vivo and clinical investigations are warranted to establish its efficacy and safety for routine medical application.