ABSTRACT

Alnıaçık, T. N. (2026). Development of Berberine-Containing Nanoemulgel Formulations and Evaluation of Antimicrobial Activity for Photodynamic Inactivation. Istanbul University, Institute of Health Science, Department of Pharmaceutical Technology, Cosmetology Division. Master's Thesis. İstanbul.

Wounds are characterized by the disruption of the normal anatomical structure and function of the skin as a result of certain chronic diseases, surgical interventions and traumatic injuries. Wound healing is a complex process aimed at restoring the structural and functional integrity of damaged tissue. Infections are among the significant complications that delay the wound healing process and negatively affect treatment success. The global increase in antibiotic resistance necessitates the development of alternative antimicrobial approaches in wound healing. In this context, antimicrobial photodynamic therapy (aPDT) is an attractive method due to its broad antimicrobial spectrum and low potential for inducing resistance. Berberine, a natural isoquinoline alkaloid, supports wound healing as a potential photosensitizer in photodynamic applications, along with its antimicrobial and anti-inflammatory properties. However, the therapeutic use of berberine is limited by its low aqueous solubility and low bioavailability.

In this thesis study, nanoemulgel formulations were developed to increase the effectiveness of berberine in topical applications. For this purpose, berberine-loaded nanoemulsions were prepared using the ultrasonication method and combined with xanthan gum gel, a natural polymer, to obtain nanoemulgel formulations. The physicochemical properties of the prepared formulations, including droplet size, polydispersity index (PDI), zeta potential, pH, conductivity, viscosity, and drug content, as well as in vitro release profiles, and antimicrobial activities were evaluated.

The obtained findings demonstrated that the berberine-loaded TCP-5 nanoemulgel formulation, with optimized physicochemical and stability characteristics, exhibited antibacterial activity against multidrug resistant bacteria isolated from wound samples under aPDT conditions. These results suggest that the developed nanoemulgel system represents a promising carrier platform for the management of wound infections and aPDT applications.

Key Words: Berberine, Nanoemulsion, Nanoemulgel, Antimicrobial photodynamic therapy, Topical delivery

The present work was supported by the Research Fund of Istanbul University. Project No: 41736