Electrospinning as an effective approach to topical delivery of natural compounds with wound healing potential

Pressure ulcers, a common condition affecting millions of people annually, not only cause immense pain and pose a threat to life but also place a financial burden on healthcare systems. These wounds, resulting from prolonged pressure, friction, or shear forces, generate significant management and treatment costs. To address this challenge, a promising solution is the development of multifunctional dressings capable of inhibiting bacterial growth and accelerating healing. Among these advances, hydrogel dressings based on nanofibers show potential in effectively treating pressure ulcers.

The use of hydrogel nanofibers in wound dressings represents a significant step forward in wound care. Both synthetic and natural polymers contribute to the production of these dressings. While synthetic polymers offer mechanical strength and thermal stability, they often lack biodegradability and key cell-binding sites essential for optimal wound healing. On the other hand, natural plant-based polymers exhibit excellent biocompatibility and biological binding sites, facilitating cell migration and tissue regeneration. By combining natural and synthetic polymers, dressings with enhanced wound-healing properties can be created. Innovatively, this project integrates plant extracts such as *Salvia officinalis*, *Thymus vulgaris*, *Syzygium aromaticum*, *Nigella sativa, Lawsonia inermis*, and Manuka honey into hydrogel nanofiber dressings to enhance their therapeutic effectiveness. These extracts possess antibacterial, anti-inflammatory, and wound-healing properties, offering a holistic approach to wound care. Manuka honey, known for its strong antibacterial activity, can serve as a contact layer for wound dressings, supporting the development of mature granulation tissue and optimizing wound healing. The project progresses in three meticulously designed stages to achieve significant milestones. The initial stage involves the extraction and characterization of plant extracts and honey, followed by evaluating their potential in wound treatment. Next, nanofibers containing these extracts are produced and subjected to rigorous analysis to determine their physicochemical properties and therapeutic effectiveness. Finally, stability controls and animal testing, simulating impaired wound healing conditions, confirm the efficacy of the developed dressing.

The importance of this project is closely tied to the prevalence and severity of pressure ulcers worldwide. By harnessing the therapeutic potential of plant extracts and advanced nanofiber technology, this endeavor aims to revolutionize wound care, providing a multifaceted approach to the complex challenges associated with pressure ulcers. Through meticulous research and interdisciplinary collaboration, the project aims to pave the way for innovative wound treatment solutions that alleviate human suffering and improve the quality of life for those affected.