Citation (Brief Summary) on the Research Work of the Applicant duly signed by the Nominator

Keywords: Biopolymers, Electrospinning, nanofiber, antibacterial, wound healing

Aim: The investigation aimed to develop a triple-layered nanofibrous wound healing dressing, as an economical and safe intervention, for the efficient healing of chronic wounds

Objectives:

- To design and develop silver nanoparticle incorporated multi-layered wound healing dressing
- To optimize the physicochemical properties and conduct cellular evaluation of the wound healing bandage
- To conduct pre-clinical studies for the developed bandage for assessing its wound healing efficacy

Methodology: Electrospun polymeric nanofibrous bandages were fabricated by the layer-by-layer approach. The outer layer is comprised of polyvinyl alcohol, a hydrophilic polymer, cross-linked with citric acid, to provide mechanical support for the middle layer. The middle layer composed of cellulose acetate was loaded with silver nanoparticles as an antibacterial agent. The lowermost layer was formulated using hydrophobic polycaprolactone to achieve a good adhesion to the skin cells. Morphological analysis of the electrospun nanofibers was conducted using field emission electron microscopy. The silver nanoparticle-loaded cellulose acetate layer was evaluated using a transmission electron microscope. The release of silver nanoparticles from the bandages was studied using inductively coupled plasma spectroscopy. The fabricated bandages were also investigated for physicochemical properties like in vitro degradation, water swelling characteristics, porosity, mechanical strength, etc. Further, the bandages were evaluated for their anti-microbial efficacy and cytotoxicity towards skin cells. The contraction and histological studies of the wounds treated with the triple-layered bandages indicated their healing efficacy in Sprague Dawley rats.

Result and Discussion: The fabricated tripe-layered nanofibrous bandages exhibited a smooth, uniform, and bead-free morphology, with the nanofiber diameter ranging between 200-400 nm. The fabricated nanofibers demonstrated excellent wettability, slow *in vitro* degradation, controlled drug release, and potent antibacterial against Gram-negative *(E.coli)* and Gram-positive (*S. aureus*) bacteria. The fabricated bandages had excellent mechanical strength upto 12.72 ±0.790 M. Pa, which was suitable for biomedical and tissue engineering applications. The bandages demonstrated excellent *in vitro* hemocompatibility and biocompatibility. *In vivo* excisional wound contraction and hematoxylin and eosin staining revealed that the fabricated wound dressing significantly accelerated the wound healing process by promoting cell proliferation and re-epithelialization. For later stages of healing, a quicker collagen deposition and complete epithelization of skin were witnessed, compared to the commercial wound dressing.

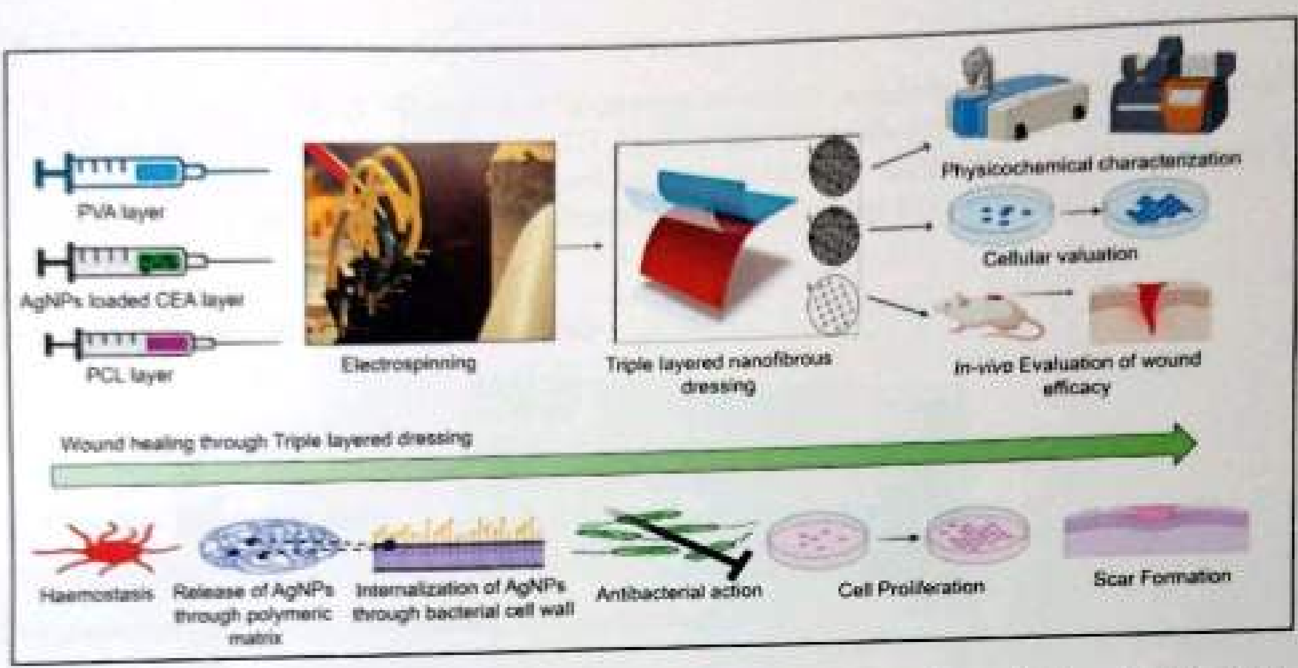

Fig 1.0 Schematic representation for methodology adopted for fabrication and characterization of triple-layered nanofibrous dressing and its mechanism for synergistic wound healing

Conclusion:

- In conclusion, we have fabricated a highly biocompatible, hemocompatible, biodegradable, antibacterial, atraumatic nanoengineered trilayered wound dressing bandage to synergies wound healing.
- The In vivo excisional wound contraction, H&E, and Masson's Trichrome staining further confirmed the nanofibrous matrix's potential in full-thickness wound healing.
- Pre-clinical investigations thus indicated the possibility of further evaluating the triple-layered nanofibrous dressing in clinical settings

References:

1. Kumar, V., et al. (2022). "Design and fabrication of a dual protein-based trilayered nanofibrous scaffold for efficient wound healing." ACS Applied Bio Materials **5**(6): 2726-2740.
2. Mistry, P., et al. (2021). "Fabrication and characterization of starch-TPU based nanofibers for wound healing applications." Materials Science and Engineering: C **119**: 111316

Acknowledgment:
DST-Nanomission, DST-INSPIRE Fellowship

Pdandekar

Dr. Prajakta Dandekar Jain
UGC Assistant Professor,
In Engineering Sciences
Institute of Chemical Technology
N. P. Marg, Matunga, Mumbai - 400 019, India

Dr.Prajakta Dandekar-Jain
UGC Assistant Professor,
Department of Pharmaceutical Sciences and Technology,
Institute of Chemical of Technology,
Matunga, Mumbai-400019