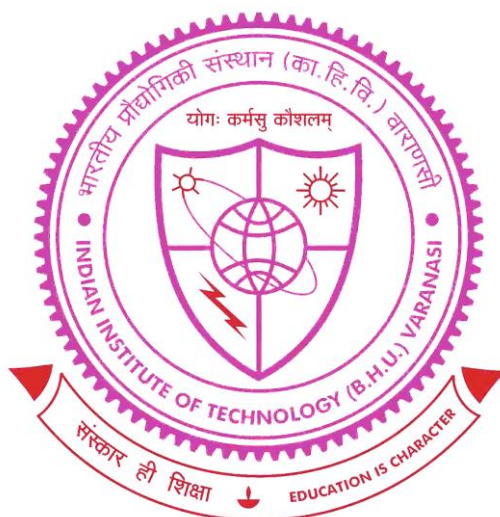


Biopolymer based nanofiber topical patches for the management of diabetic fungal wounds



Thesis submitted in partial fulfilment

for the Award of Degree

DOCTOR OF PHILOSOPHY

By

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*Dedicated to the Almighty & My
Family*

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Abbreviations & Symbols

%	Percentage
°C	Degree Celsius
Aq.	Aqueous
AgNP	Silver nanoparticles
AFM	Atomic force microscopy
ANOVA	Analysis of variance
ATR	Attenuated total reflectance
AUC	Area under the curve
C6	Coumarin-6
CH	Chitosan
DMEM	Dulbecco's modified eagle's medium
DSC	Differential scanning calorimetry
EE	Entrapment efficiency
FBS	Fetal bovine serum
FDA	United states food and drug administration
FTIR	Fourier transform infrared spectroscopy
GL-PCL	Gelatin coated PCL nanofiber
GL-PCL-LTZ	Luliconazole loaded GL-PCL nanofiber
GL-PCL-NAR	Naringenin loaded GL-PCL nanofiber
GL-PCL-LTZ./NAR	Luliconazole and naringenin loaded GL-PCL nanofiber
GL	Gelatin
h/hr	Hour(s)
HaCaT	Human epidermal keratinocytes
HPLC	High-performance liquid chromatography
i.p.	Intraperitoneal
kDa	Kilo Dalton
LZ/LTZ	Luliconazole
LOD	Limit of detection
LOQ	Limit of Quantification

LZNP	PLGA Luliconazole nanoparticle
MDR	Multi drug resistance
kV	Kilo volt
NIR	Near infrared
NF	Nanofiber
mg	Milligram
min	Minute
ml	Millilitre
MTT	3-(4,5-dimethylthiazolyl-2-yl)-2, 5 diphenyl-tetrazolium-bromide
NaOH	Sodium hydroxide
nm	Nanometre
NP/NPs	Nanoparticles
PBS	Phosphate buffer saline
PCL	Poly (ϵ -caprolactone)
PVA	Poly vinyl alcohol
PLGA	poly(lactide-co-glycolide)
PVA/CH NF	PVA/CH nanofiber
PVA/CH-AgNP NF	AgNP loaded PVA/CH nanofiber
PVA/CH-LZNP NF	LZNP loaded PVA/CH nanofiber
PVA/CH-AgNP-LZNP NF	LZNP and AgNP loaded PVA/CH nanofiber
rpm	Revolutions per minute
S.D.	Standard deviations
sec	Seconds
SPM	Scanning probe microscopy
TEM	Transmission electron microscopy
TPGS	D- α -tocopheryl polyethylene glycol 1000 succinate
μ g	Microgram
μ l	Microliter
μ M	Micromole
XRD	X-ray diffraction spectroscopy

Preface

Diabetic wounds pose a significant challenge in healthcare due to their slow healing process and susceptibility to complications. Individuals afflicted with diabetes often encounter difficulties in wound management, leading to prolonged suffering and increased healthcare costs. The conventional treatment methods, such as the application of marketed creams, exhibit several limitations that hinder their efficacy in diabetic wound healing. These limitations include the need for repetitive application over the wound area, short drug release time, and vulnerability to removal during daily activities. The inadequacies of conventional treatments underscore the pressing need for innovative solutions to address the complexities associated with diabetic wound management.

In recent years, nanotechnology has emerged as a promising avenue for revolutionizing wound care. Nanofiber-based dressings have garnered significant attention due to their unique properties, including high surface area-to-volume ratio, tunable porosity, and ability to encapsulate therapeutic agents. These characteristics make nanofibers an ideal platform for controlled drug delivery and enhanced wound healing. Leveraging the advantages of nanofibers, researchers have explored novel formulations to overcome the limitations of conventional treatments and provide effective solutions for diabetic wound management.

In this dissertation, we present a comprehensive investigation into the preparation of nanofiber-based dressings for diabetic wound healing. Our research focuses on the development of two distinct nanofiber formulations, each tailored to address challenges associated with diabetic wounds. The first approach involves the fabrication of Polyvinyl alcohol (PVA) and chitosan-based composite nanofibers loaded with Poly(lactic-co-glycolic acid) luliconazole nanoparticles (NPs) and silver nanoparticles. This formulation harnesses the combine effects of luliconazole, a potent antifungal agent, and silver

nanoparticles, renowned for their antimicrobial and antioxidant properties, to combat infections commonly observed in diabetic wounds.

In the second approach, we explore the utilization of gelatin-coated Polycaprolactone (PCL) nanofibers loaded with luliconazole and naringenin. Naringenin, a flavonoid with antioxidant properties, is incorporated to mitigate oxidative stress, a critical factor impeding wound healing in diabetic individuals. By combining luliconazole with naringenin within a gelatin-coated PCL nanofiber matrix, we aim to enhance the therapeutic efficacy of the dressing while promoting the regeneration of damaged tissues.

Throughout this dissertation, we delve into the intricate details of nanofiber preparation, characterization, and evaluation of their performance in diabetic wound healing. Our research endeavours to contribute to the growing body of knowledge in the field of nanotechnology-enabled wound care, with a focus on addressing the unmet needs of diabetic patients. By elucidating the potential of nanofiber-based dressings loaded with therapeutic agents, we aspire to pave the way for the development of advanced wound management strategies that offer improved outcomes and enhanced quality of life for individuals grappling with diabetic wounds.