IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, April 2026
Impact Factor: 8.2

Exploratory Evaluation of a Hybrid Drug-Loaded Nanofiber Patch for Diabetic Wound Repair

Satish Digambar Mendake[1] and Dr. Sunita Arya[2]*
[1]PhD Scholar; [2]PhD Guide, Faculty of Pharmacy
P.K. University, Karera, Shivpuri, Madhya Pradesh, India
Corresponding author*: Dr. Sunita Arya

Abstract: *Diabetic wounds frequently exhibit delayed repair and persistent inflammation. Electrospun nanofibers can act as local drug-delivery scaffolds, and prior animal work has evaluated antidiabetic-drug-loaded fibers for wound repair [2,3]. To organize the wound-healing findings reported in the supplied thesis for a hybrid PVA–gelatin nanofiber patch containing metformin and sitagliptin-associated solid lipid nanoparticles. The thesis describes a comparison of untreated diabetic wounds, plain drug-loaded nanofiber patches, and hybrid nanoparticle-in-nanofiber patches, with wound area followed to day 14 and histology described qualitatively. Complete details of wound induction, treatment allocation, sample size, blinding, and ethics approval were not available and require confirmation. The supplied results table reports day-14 wound area remaining of 59.8 ± 8.0% for untreated controls, 30.5 ± 6.6% for plain nanofiber patches, and 5.2 ± 2.0% for hybrid patches. These correspond to approximate wound closure of 40%, 69.5%, and 94.8%, respectively. The day-7 value for the plain patch is explicitly incomplete in the source and is not reported here. The thesis-reported day-14 values suggest a possible improvement in wound closure with the hybrid patch. Because essential methods and data verification are outstanding, the findings should be regarded as exploratory and cannot support efficacy or safety conclusions until checked against the original records.*

Keywords: diabetic wound; electrospun nanofiber; metformin; sitagliptin; solid lipid nanoparticles; topical delivery; wound closure.

I. INTRODUCTION

Diabetes prevalence continues to increase globally, with the Global Burden of Disease Study estimating 529 million people with diabetes in 2021 and projecting more than 1.31 billion by 2050 [1]. Diabetes can impair wound repair, and chronic diabetic ulcers remain a substantial clinical problem. Nanofibrous scaffolds are under investigation as local delivery matrices and wound-contact materials because their fibrous structure can be engineered for drug loading and release [2,5].

Experimental studies have explored local delivery of antidiabetic agents from electrospun scaffolds. Cam and colleagues reported improved diabetic wound-healing outcomes using combination antidiabetic-agent-loaded nanofibrous scaffolds in an animal model [3]. These reports provide context for investigating local drug delivery; however, results from one drug combination, material, or animal model cannot be generalized to another.

The supplied thesis describes a hybrid patch in which metformin is loaded in a PVA–gelatin fiber matrix and sitagliptin is associated with embedded SLNs. This manuscript draft focuses on the thesis-reported wound closure findings. It does not assume that systemic glucose control, local anti-inflammatory action, or clinical benefit has been demonstrated by the wound-area data alone.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, April 2026
Impact Factor: 8.2

II. MATERIALS AND METHODS

2.1 Study design and test article

The source thesis describes three comparison groups: untreated diabetic wound control, plain drug-loaded nanofiber patch, and hybrid drug-loaded nanoparticle-in-nanofiber patch. The hybrid formulation is described as a PVA–gelatin matrix carrying metformin with sitagliptin-loaded SLNs. Materials, preparation steps, and some composition details are presented in the companion formulation manuscript draft. Before submission, authors must confirm that these materials and formulations were the actual test articles used in the wound study.

2.2 Animals, diabetes induction, and wound protocol

The thesis mentions Wistar rats and describes a high-fat diet with streptozotocin, with or without nicotinamide, in different chapters. It does not provide a complete, internally consistent account of the diabetes model used for the wound experiment. The wound creation method, wound location and dimensions, inclusion criteria, glucose threshold, animal sex, age, weight, group size, randomization, allocation concealment, blinding, analgesia, dressing-change schedule, and euthanasia/histology time points should be inserted from approved protocols and study records. The source contains an animal ethics placeholder ("XYZ123"); this must be replaced with the verified committee name and approval number, or the study must not be represented as approved. Animal-study reporting should follow ARRIVE 2.0 [4].

2.3 Outcomes and analysis

The primary outcome described in the thesis is wound area remaining as a percentage of the original wound area, with percentage closure calculated as 100 minus percentage area remaining. A summary table reports day-7 and day-14 measures, but the day-7 plain-patch entry is marked as missing and a narrative note says it is an assumption. That value is excluded. The reported day-14 values are presented as means ± standard deviation; the source table states n=5 wounds per group, but the unit of analysis and number of animals require verification. No inferential statistical testing is reproduced here because the raw observations, analysis plan, and complete statistical output were not provided. Any final analysis should account for repeated measurements and the animal as the experimental unit, as appropriate.

III. RESULTS

Only the reported day-14 table values are summarized. "Approximate closure" is calculated as 100% minus the reported wound area remaining; no inferential comparisons are asserted.

Table 1. Thesis-reported day-14 wound area remaining and calculated closure.

Group	Wound area remaining, day 14 (%)	Approximate closure, day 14 (%)	Status
Untreated diabetic control	59.8 ± 8.0	40.2	Reported in source table
Plain drug-loaded nanofiber patch	30.5 ± 6.6	69.5	Reported in source table
Hybrid nanoparticle-in-nanofiber patch	5.2 ± 2.0	94.8	Reported in source table

The thesis also describes qualitative histology favoring the hybrid group, including more complete epithelial coverage and granulation tissue. The underlying images, scoring method, blinded assessment, and quantitative histology measurements were not supplied; these statements are therefore not presented as independently confirmed outcomes in this draft.

IV. DISCUSSION

The summary table reports lower wound area remaining at day 14 in the two patch groups than in the untreated control, with the smallest reported residual area in the hybrid-patch group. The magnitude and direction of this pattern are

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, April 2026
Impact Factor: 8.2

consistent with continued investigation of drug-loaded nanofiber dressings. Related preclinical work has also examined antidiabetic-drug-loaded scaffolds for diabetic wound repair [3], while broader reviews describe the proposed roles of nanofiber-based systems in diabetes-related applications [2].

These observations cannot establish that the hybrid carrier caused the apparent difference. The supplied thesis does not provide sufficient study-level information to evaluate baseline comparability, wound measurement reliability, attrition, sample-size justification, randomization, blinding, or the statistical unit. The source explicitly labels one day-7 value as missing and assumed; that number has not been used. The diabetes induction protocol also differs across thesis sections, and the animal ethics approval number is a placeholder. Such gaps prevent a journal-ready assessment of internal validity and reproducibility.

The mechanism also remains uncertain. A wound-contact patch could influence moisture balance, wound coverage, local exposure to drug, and release behavior. The thesis does not include a blank-fiber group in the reported table, a matched-dose free-drug group, or a clear comparator for standard wound care. As a result, the contribution of the polymer scaffold, the drug combination, the SLNs, and dosing cannot be separated. Prior work using other antidiabetic combinations and different scaffold materials provides biological context but does not establish the mechanism of this test article [3]. The next step should be source-data reconciliation rather than stronger interpretation. Confirm each animal's measurements and treatment assignment, retrieve original wound photographs, prespecify the analysis, report exclusions and adverse events, and provide histology images with blinded scoring. An adequately powered design with a blank patch and drug-matched controls would help identify the effects attributable to the material and to the active ingredients. The final manuscript should follow ARRIVE 2.0 and report the exact approved protocol and animal welfare measures [4].

V. CONCLUSION

The thesis-reported day-14 wound-area summary shows a descriptive pattern of greater closure in the patch-treated groups, particularly the hybrid formulation. The missing and inconsistent study details prevent causal or translational conclusions. After verification of raw wound measurements, protocol and ethics records, sample size, analysis, and histology, these results may form the basis of an exploratory preclinical report. No clinical efficacy claim is supported by the supplied material.

REFERENCES

1. GBD 2021 Diabetes Collaborators. Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. Lancet. 2023;402(10397):203–234. doi:10.1016/S0140-6736(23)01301-6.
2. Maleki H, Khoshnevisan K, Sajjadi-Jazi SM, Baharifar H, Doostan M, Khoshnevisan N, et al. Nanofiber-based systems intended for diabetes. J Nanobiotechnology. 2021;19(1):317. doi:10.1186/s12951-021-01065-2.
3. Cam ME, Ertaş B, Alenezi H, Hazar-Yavuz AN, Esendağlı G, Ekentok C, et al. Accelerated diabetic wound healing by topical application of combination oral antidiabetic agents-loaded nanofibrous scaffolds: an in vitro and in vivo evaluation study. Mater Sci Eng C Mater Biol Appl. 2021;119:111586. doi:10.1016/j.msec.2020.111586.
4. Percie du Sert N, Hurst V, Ahluwalia A, Alam S, Avey MT, Baker M, et al. The ARRIVE guidelines 2.0: updated guidelines for reporting animal research. PLoS Biol. 2020;18(7):e3000410. doi:10.1371/journal.pbio.3000410.
5. Xue J, Wu T, Dai Y, Xia Y. Electrospinning and electrospun nanofibers: methods, materials, and applications. Chem Rev. 2019;119(8):5298–5415. doi:10.1021/acs.chemrev.8b00593.
6. Sharma A, Gupta A, Rath G, Goyal A, Mathur RB, Dhakate SR. Electrospun composite nanofiber-based transmucosal patch for anti-diabetic drug delivery. J Mater Chem B. 2013;1(27):3410–3418. doi:10.1039/C3TB20487A.
7. Vijayan A, Nanditha CK, Vinod Kumar GS. ECM-mimicking nanofibrous scaffold enriched with dual growth factor carrying nanoparticles for diabetic wound healing. Nanoscale Adv. 2021;3(11):3085–3092. doi:10.1039/D0NA00926A.