

Abstract

Biochemical and Hematological Modulation by Smart Biomaterial-Based Therapies in Diabetic Wounds [†]

Gildemar J. B. Crispim ^{1,2,*}, Gabriella O. Silva ^{1,2}, Paulo H. Oliveira ^{2,3}, Lara S. Almeida ^{1,2}, Mosar C. Rodrigues ^{1,2}, Graziella A. Joanitti ² and Marcella L. B. Carneiro ²

¹ Postgraduate Program in Nanoscience and Nanobiotechnology, Institute of Biology, University of Brasília-UnB, Brasília 70910-900, Brazil; oliveiragaby101@gmail.com (G.O.S.)

² Laboratory of Bioactive Compounds and Nanobiotechnology, University of Brasília-UnB, Brasília 70910-900, Brazil; marbretas@unb.br (M.L.B.C.)

³ Graduate Program in Biomedical Engineering, Faculty of Science and Engineering Technologies (FCTE), University of Brasília-UnB Gama, Brasília 72444-240, Brazil

* Correspondence: gildemar.crispim@unb.br

[†] Presented at the 6th International Congress on Health Innovation—INOVATEC 2025, Hybrid, 21–23 November 2025.

Keywords: hematological profile; diabetes; immunomodulation

Introduction: Diabetes Mellitus (DM) impairs wound healing due to persistent hyperglycemia, promoting chronic inflammation and increasing infection risk. Biochemical markers such as blood glucose and HbA1c confirm the diabetic state, while hematological analyses reflect systemic immune modulation in response to therapies. **Methodology:** Male Balb/c mice with streptozotocin-induced diabetes were confirmed diabetic by fasting blood glucose (≥ 200 mg/dL) and HbA1c $\geq 6.0\%$. Full-thickness wounds were created, infected with *Staphylococcus aureus*, and treated for 14 days with: G1—saline, G2—antibacterial ointment, G3—blue LED, G4—NLB + LED, G5—NLB with nanoemulsions (CuraTex), G6—CuraTex + LED, and G7—Nanoemulgel + LED. Treatments were applied every 48 h, with 5 min phototherapy sessions. Blood samples were analyzed for glucose, HbA1c, hemoglobin, hematocrit, blood cells, platelets, and leukocyte differential. All procedures were conducted in accordance with ethical standards and approved by the Institutional Animal Care and Use Committee (Comitê de Ética em Pesquisa) under protocol n° 23106.029983/2024-69. **Results:** Control groups showed hyperglycemia, anemia, and neutrophilic leukocytosis. LED reduced inflammation and normalized leukocyte counts. NLB improved neutrophil–lymphocyte balance, and NLB + LED promoted hematological stability. CuraTex + LED and Nanoemulgel achieved the best results, enhancing lymphocyte recovery and immune modulation. **Conclusions:** The combination of CuraTex and LED phototherapy modulated inflammation and improved immune balance in diabetic mice, highlighting its potential as an innovative and ethically validated therapy for chronic wounds.



Academic Editors: Andreanne Vasconcelos, Amílcar Damazo and José Roberto Leite

Published: 25 February 2026

Copyright: © 2026 by the authors.

Licensee MDPI, Basel, Switzerland.

This article is an open access article distributed under the terms and conditions of the [Creative Commons Attribution \(CC BY\)](https://creativecommons.org/licenses/by/4.0/) license.

Author Contributions: Conceptualization, G.J.B.C. and M.L.B.C.; methodology, G.J.B.C., G.O.S., P.H.O., L.S.A. and M.C.R.; validation, G.J.B.C. and M.L.B.C.; formal analysis, G.J.B.C. and M.L.B.C.; investigation, G.J.B.C., G.O.S., P.H.O., G.A.J., L.S.A. and M.C.R.; resources, M.L.B.C.; data curation, G.J.B.C.; writing—original draft preparation, G.J.B.C.; writing—review and editing, M.L.B.C.; visualization, G.J.B.C.; supervision, M.L.B.C.; project administration, G.J.B.C. and G.A.J.; funding acquisition, M.L.B.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Research Support Foundation of the Federal District (FAPDF), process n° 00193.00002360/2022-11, and by the Coordination for the Improvement of Higher Education Personnel (CAPES), Finance Code 001.

Institutional Review Board Statement: The animal study protocol was approved by the Ethics Committee on Animal Use (CEUA) of University of Brasília, under protocol number 23106.029983/2024-69, in accordance with national legislation and international guidelines for the care and use of laboratory animals.

Informed Consent Statement: Not applicable. This study did not involve human participants.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to institutional restrictions.

Conflicts of Interest: The authors declare no conflict of interest.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.