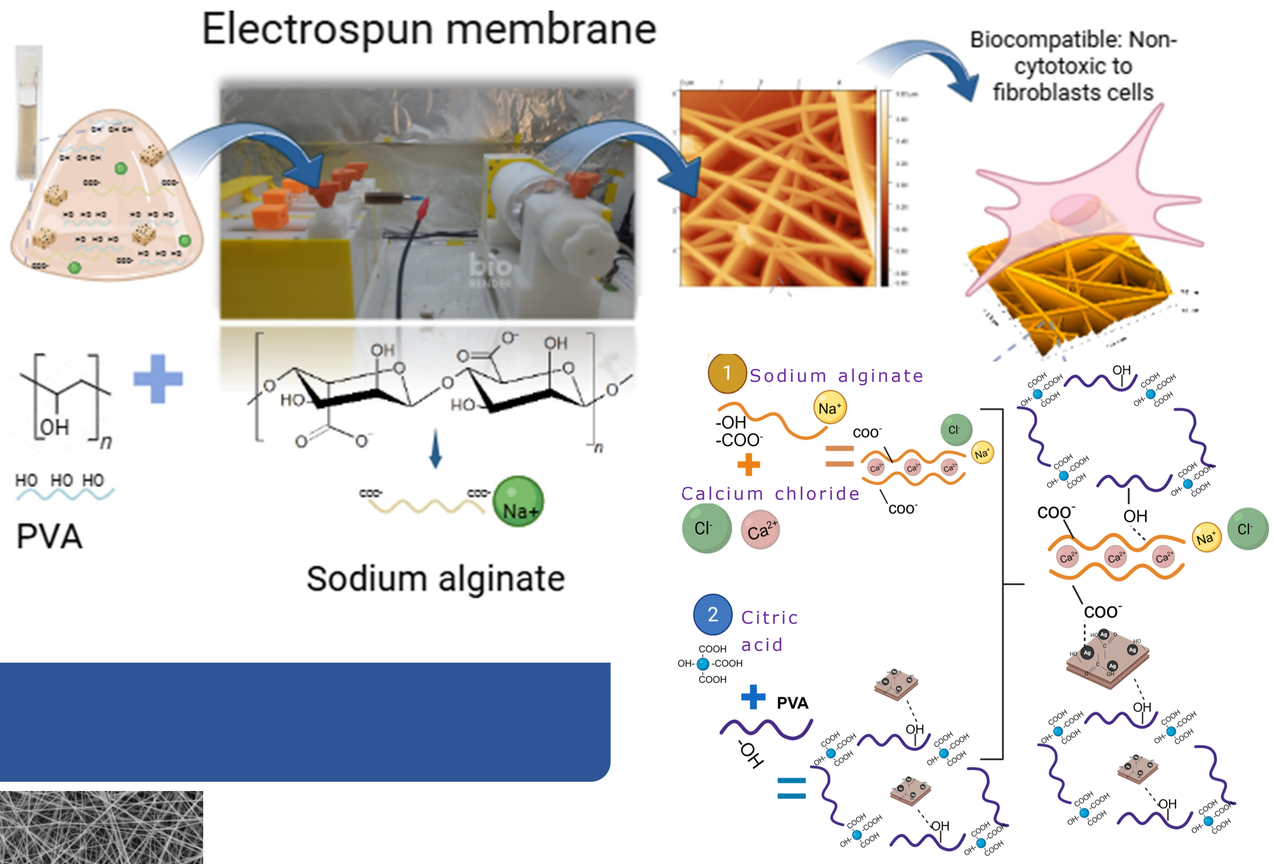
Biodegradable nanofibrous dressing incorporating GOAg for enhanced antimicrobial performance in chronic wound treatment

Thamyres F. Da Silva[1], Francisco F. Pereira[1], Ana L. De B. Soares[1], Rebeca M. Chaves[1], Rodrigo S. Vieira[1], Fábia K. Andrade[1].
*thamyres.freire@alu.ufc.br, PhD student
[1]Department of Chemical Engineering, Federal University of Ceará, 60455-760, Fortaleza, Ceará, Brazil.

INTRODUCTION

Skin wound infections are commonly treated with systemic antibiotics, but their overuse can promote antimicrobial resistance, especially in *S. aureus* and *P. aeruginosa*.[1] To improve the management of both acute and chronic wounds, advanced wound dressings have been developed. In this context, the present study introduces a nanotechnology-based dressing composed of graphene, silver nanoparticles, and biodegradable polymers. The electrospinning method was employed to ensure uniform nanoparticle incorporation within the membrane, resulting in a porous structure capable of controlled silver release.

METHODOLOGY



RESULTS

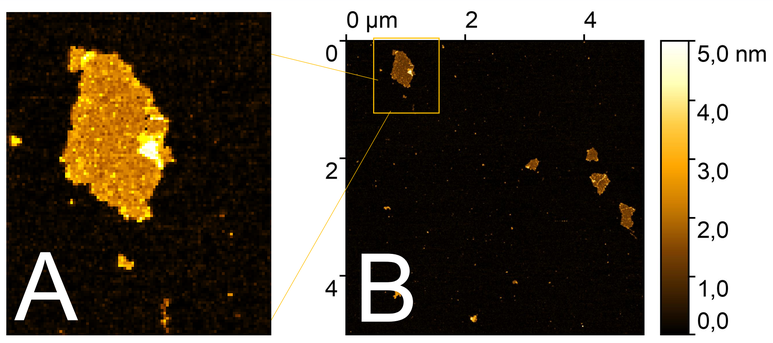


Figure 1. Atomic force microscopy (AFM) images of GOAg sheets. (A) Close-up of a single sheet. (B) Wider-area scan image showing the distribution of the sheets on the substrate, with the region magnified in (A) highlighted (square). The scale bar indicates a height range from 0 to 5.0 nm.

The atomic force microscopy (AFM) images of GOAg sheets exhibits a flake structure with silver nanoparticles in the surface, Figure 1A. In the larger scan area, multiple GOAg sheets are dispersed showing limited aggregation, Figure 1B. The GOAg exhibited antimicrobial activity against *S. aureus* at concentrations of GO: 13.12 µg/mL and Ag: 26.25 µg/mL (Figure 2A) and against *P. aeruginosa* at GO: 39.06 µg/mL and Ag: 52.50 µg/mL (Figure 2B)

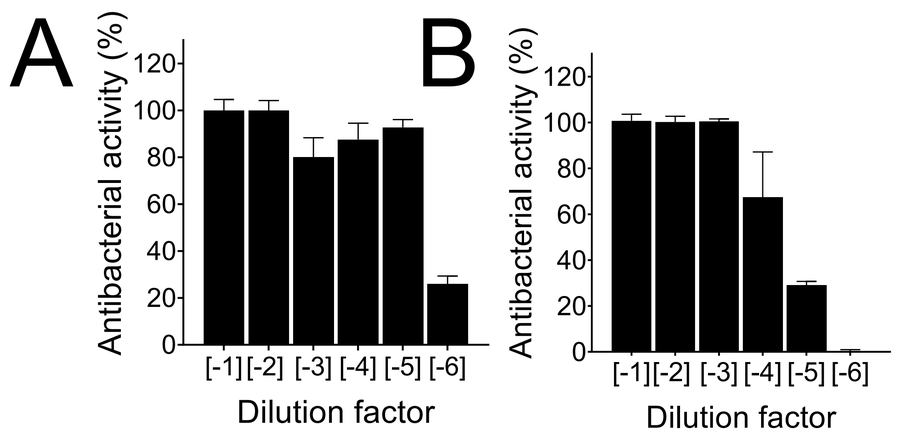
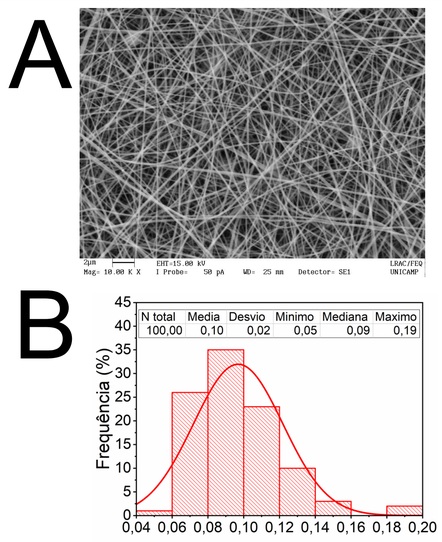


Figure 2. Antimicrobial activity of the GOAg (A) against *S. aureus* and (B) *P. aeruginosa*



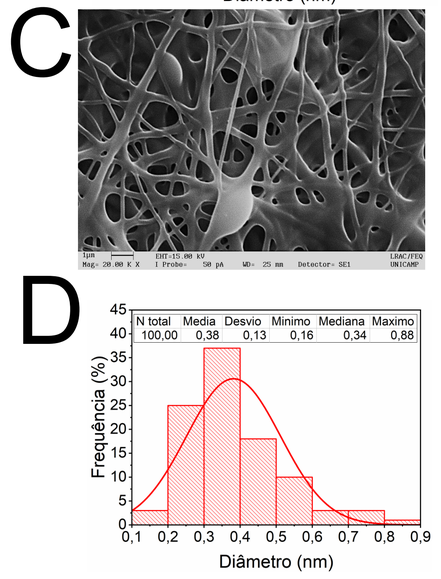


Figure 3. Scanning electron microscopy (SEM) images and fiber diameter distribution for the electrospun membranes. (A) Micrograph of the membrane before cross-linking. (B) Histogram of the corresponding diameter distribution, showing a mean of 0.10 ± 0.02 µm, with a range between 0.05 and 0.19 µm. (C) SEM after the cross-linking process. (D) Histogram of the diameter distribution after crosslinking, with a mean of 0.38 ± 0.13 µm.

The PVA-SA-GOAg electrospun membrane was showed in Figure 3A-B. We see the nanofibers formed with magnitude of 100 ±16.25 nm. The sodium alginate cross-linking with $CaCl_2$ in ethanol to produce calcium alginate can be seen in Figure 3C-D, with an increase in the diameter of the nanofibers.

The 24-hour membranes extract showed antimicrobial action against *S aureus* and *P aeruginosa*, inhibiting the strains by >70%. In the *in vitro* cytotoxicity test, the PVA-SA-GOAg membrane showed non cytotoxic to L-929 cells in 24 and 48h, Figure 4.

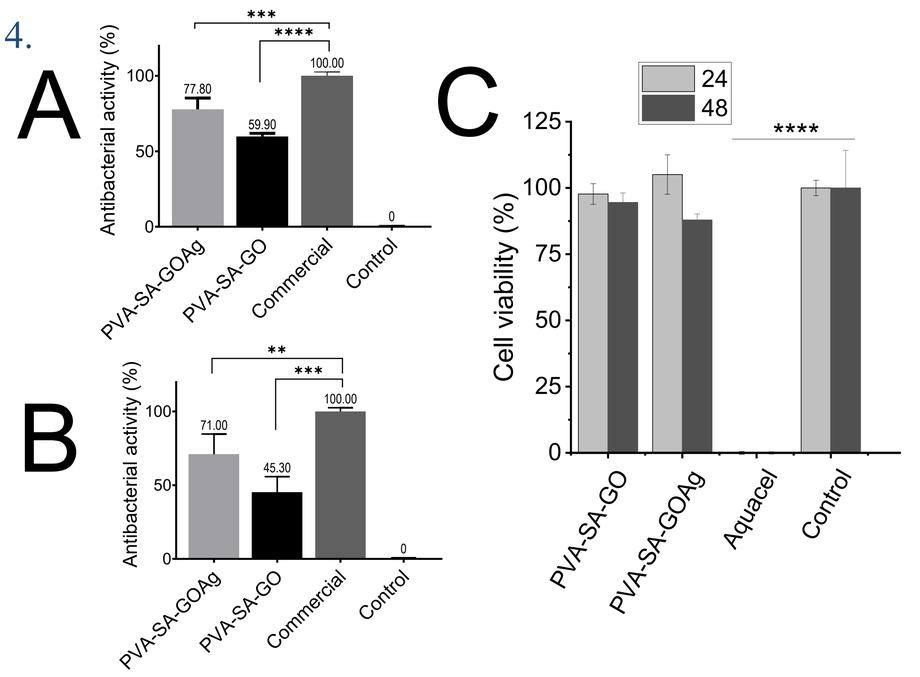


Figure 4: Antimicrobial activity and cytotoxicity evaluation of the developed membranes. (A) Antibacterial effect against *S. aureus,* (B) Antibacterial effect against *P. aeruginosa* and (C) *in vitro* cytotoxicity assessment using L929 fibroblast cells after 24 and 48 h of exposure.

CONCLUSION

The electrospun PVA-SA-GOAg membrane demonstrated promising antimicrobial efficacy against both *S. aureus* and *P. aeruginosa*, while maintaining acceptable levels of cytocompatibility. The incorporation of silver and graphene oxide into biodegradable polymers resulted in a nanostructured material. These findings highlight the membrane potential as an advanced wound dressing. Future work could include studies on the addition of a new layer as a form of improving antimicrobial activity

REFERENCES

1. Wardell SJT, Yung DBY, Nielsen JE, Lamichhane R, Sørensen K, Molchanova N, et al. A biofilm-targeting lipo-peptoid to treat Pseudomonas aeruginosa and Staphylococcus aureus co-infections. Biofilm. 2025 Jun 1;9.

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