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Antimicrobial Biopolymeric Film for Burn Wound Applications

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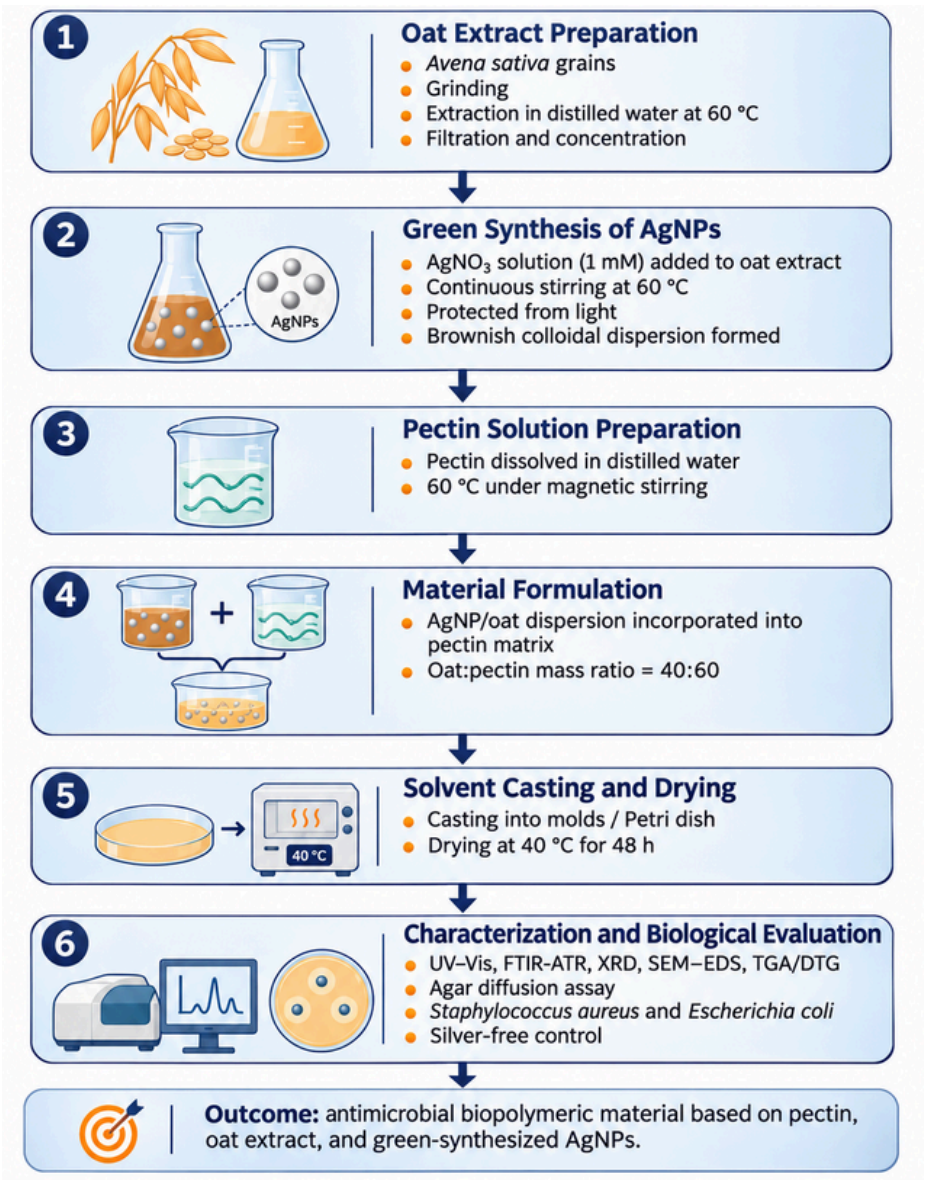
Introduction

Burn injuries represent a significant public health concern due to the high risk of infections and the need for effective wound management. Pectin-based biopolymeric materials have emerged as promising alternatives because of their biodegradability and potential biomedical applications. The incorporation of silver nanoparticles (AgNPs), synthesized through environmentally friendly methods using oat extract, offers a sustainable strategy for developing antimicrobial materials with potential applications in burn wound dressings.

Objectives

To develop and characterize an antimicrobial biopolymeric material based on pectin, incorporating silver nanoparticles (AgNPs) synthesized through a green route using aqueous oat extract, aiming at potential applications in burn wound dressings.

Methodology



Results and Discussion

Commercial high-methoxyl pectin exhibited a degree of esterification of approximately 66% and a viscosity-average molar mass of 4.84 × 10⁵ g/mol. FTIR analysis revealed characteristic functional groups, while TGA/DTG indicated a main degradation event near 310 °C.

ANTIMICROBIAL ACTIVITY

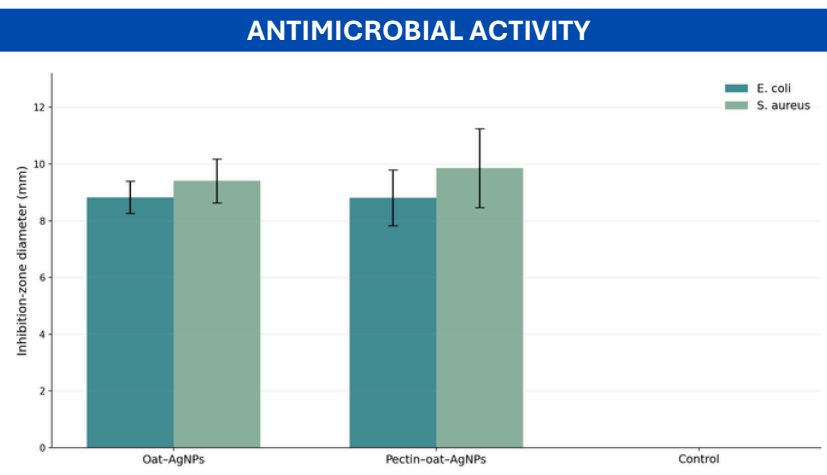


Figure 1. Mean inhibition-zone diameters (± standard deviation) against *E. coli* and *S. aureus* for AgNP-containing formulations and the silver-free control.

AGAR DIFFUSION - *E. COLI*

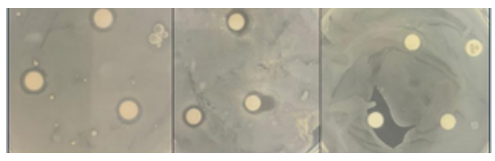


Figure 2. Representative agar diffusion assay against *Escherichia coli*, comparing the oat–AgNP dispersion, pectin–oat/AgNP matrix, and AgNP-free control.

AGAR DIFFUSION - *S. AUREUS*

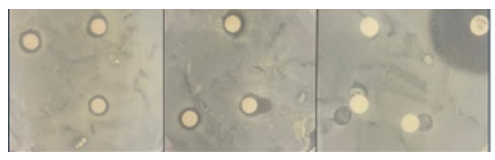


Figure 3. Representative agar diffusion assay against *Staphylococcus aureus*, comparing the oat–AgNP dispersion, pectin–oat/AgNP matrix, and AgNP-free control.

AgNP FORMATION - UV–VIS

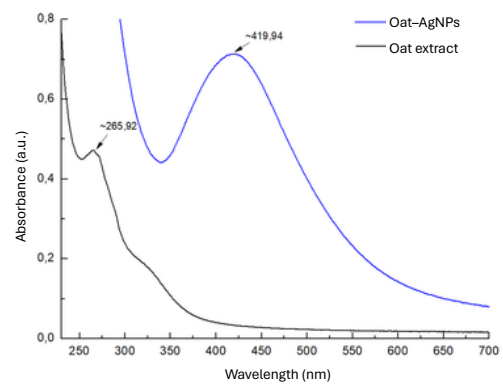


Figure 4. UV–Vis absorption spectrum of the oat–AgNP dispersion, showing a surface plasmon resonance band at 419.9 nm.

STRUCTURAL CHARACTERIZATION

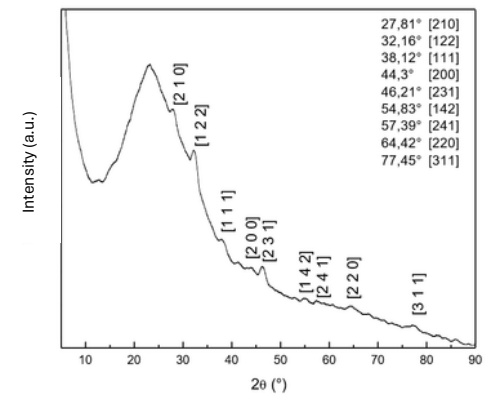


Figure 5. X-ray diffraction pattern of the pectin–oat/AgNP material, showing characteristic crystalline silver reflections and an estimated crystallite size of approximately 4.6 nm..

ELEMENTAL ANALYSIS · EDS

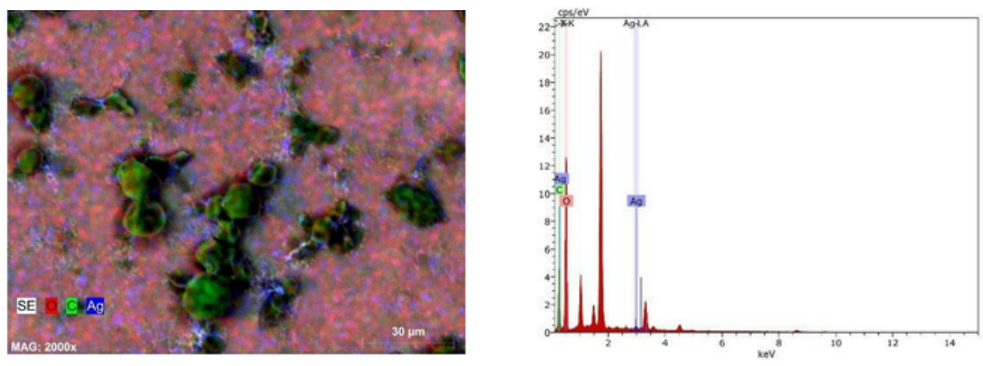


Figure 6. SEM–EDS elemental mapping and spectrum of the pectin–oat/AgNP matrix, showing the elemental distribution and a characteristic Ag signal near 3 keV.

Conclusions

Green synthesis
UV–Vis evidence consistent with AgNP formation.

Antimicrobial activity
Inhibition of both tested bacterial species.

Future studies
Matrix optimization and biocompatibility assessment.

References and Acknowledgements

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