GREEN SYNTHESIS OF SILVER NANOPARTICLES-PEPTIDE HYDROGEL COMPOSITE FILM AND ITS ANTIBACTERIAL ACTIVITY

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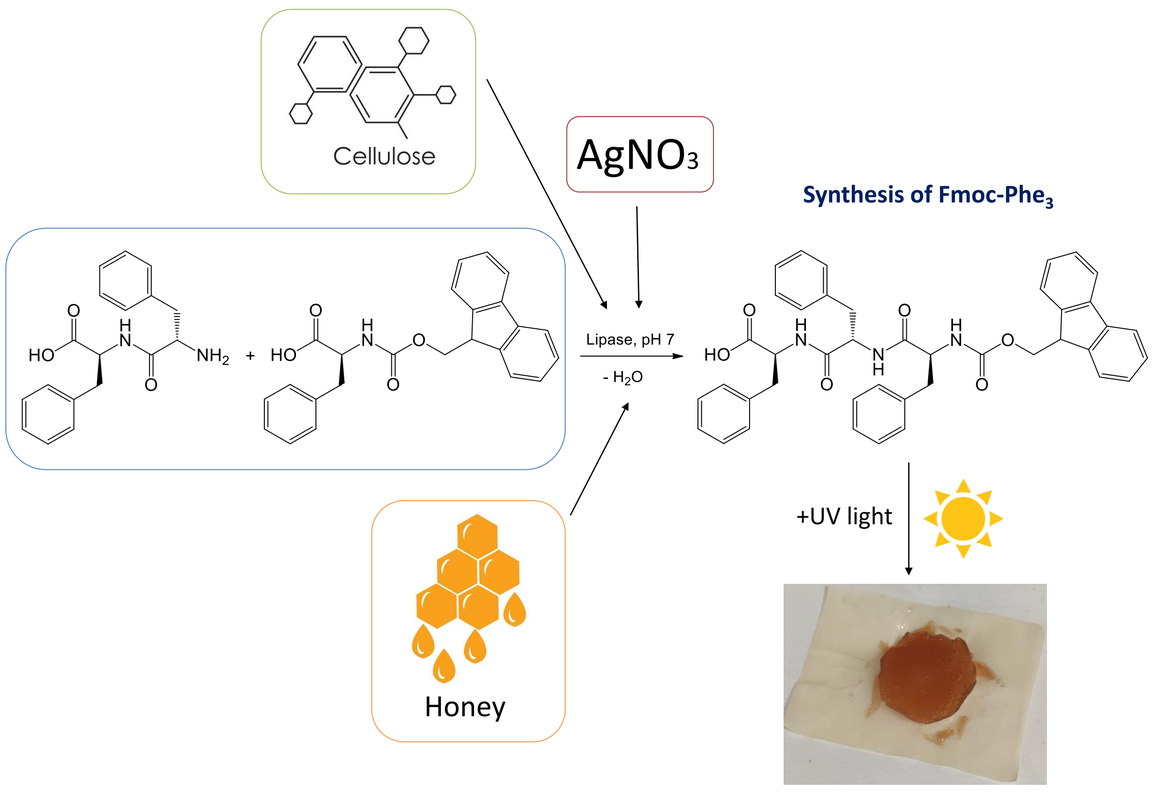
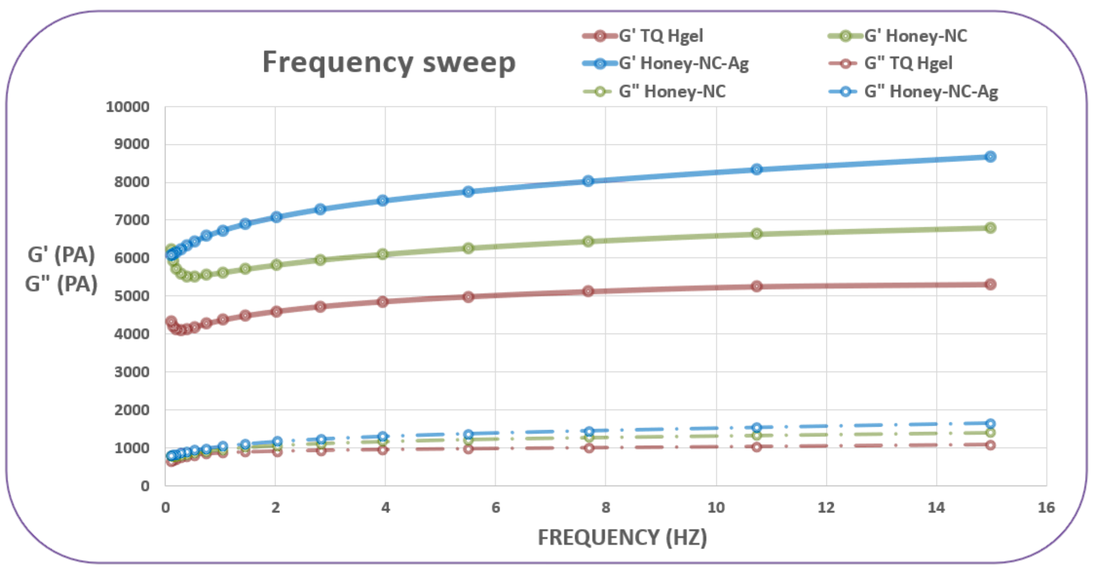
The development of innovative antibacterial hydrogels is crucial for biomedical applications, particularly in wound healing and antimicrobial coatings.
In this work we synthesized a gelling tripeptide Fluorenylmethyloxycarbonyl-triphenylalanine (Fmoc-Phe_3, TQ hydrogel) via enzymatic method, containing photo-generated silver nanoparticles (AgNPs) obtained in presence of honey and microcrystalline cellulose (NC) as tensile strenght enhancers and hydrogel stabilizers. We evaluated the structure and morphology of the nanohybrids and the antibacterial activity of these biomaterials was investingating using *Staphylococcus aureus* ATCC 6538.

Hydrogel Synthesis



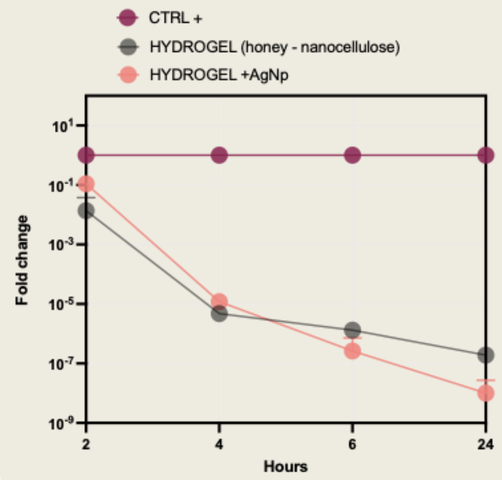
Rheological measurements



The presence of honey and NC affects the viscoelastic behavior of the hydrogels. These results suggested that incorporating them with AgNPs inside the matrix increase the mechanical strength in both G' and G'' compared with TQ hydrogel.

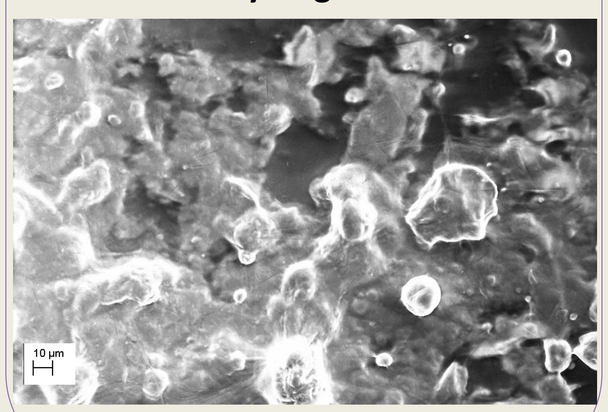
Antibacterial activity and SEM images

Antibacterial activity of the film



The chart illustrates the antibacterial efficacy between two honey-NC hydrogels, with and without AgNPs over a 24-hour timeframe. Both of them exhibit substantial antimicrobial efficacy during the initial 4-hour interval. AgNPs-honey-NC hydrogel demonstrates superior performance in sustaining a reduced bacterial presence, thereby indicating its enhanced capability in mitigating microbial proliferation in time.

SEM image of AgNPs-honey-NC hydrogel



The image displays a microscopic view of silver nanoparticles, seen as bright spots scattered across a darker background. These light areas represent individual or clustered silver particles, highlighting their distribution and morphology at the nanoscale level.

Conclusions and Future Perspective

The green synthesis of silver nanoparticle–peptide hydrogel composites offers a promising route for developing multifunctional materials with potent antibacterial activity. The incorporation of natural agents like honey and microcrystalline cellulose has proven effective not only in refining nanoparticle uniformity and reducing particle size but also in enhancing the mechanical strength and structural stability of the hydrogel matrix. These improvements make the material particularly suitable for biomedical applications such as wound healing, where durability and antimicrobial efficacy are key.

To advance the clinical applicability of the peptide-based hydrogel composite, further in vivo investigations are warranted to comprehensively assess its biocompatibility, therapeutic efficacy, and long-term safety, particularly in the context of wound healing and biomedical coatings. Broadening the antimicrobial spectrum to include resistant bacterial strains (such as *Escherichia coli)* may significantly enhance the material's versatility and clinical relevance. Additionally, the integration of stimuli-responsive elements (pH, temperature, or enzyme-sensitive moieties) could facilitate the development of smart delivery systems capable of site-specific and controlled release of silver ions. Finally, the hydrogel's mechanical robustness and tunable structural properties position it as a promising candidate for advanced bioengineering applications, including the fabrication of tissue scaffolds and customizable antimicrobial surfaces via additive manufacturing technologies.

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