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OPTIMIZING THE GREEN SYNTHESIS OF SILVER NANOPARTICLES WITH POMEGRANATE EXTRACT FOR ANTIBACTERIAL PURPOSES: AN INNOVATIVE APPROACH

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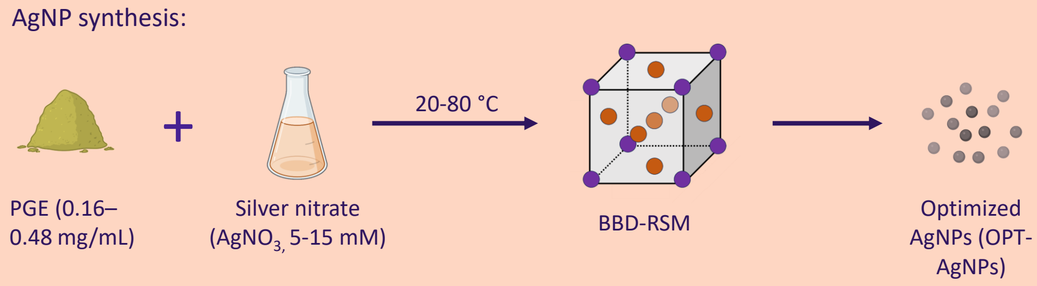
INTRODUCTION

Silver nanoparticles (AgNPs) have attracted significant attention due to their remarkable antimicrobial and biocidal properties. Green synthesis, which utilizes plant extracts as reducing and stabilizing agents, offers an eco-friendly alternative to traditional methods, reducing toxicity and enhancing biocompatibility. Among natural sources, pomegranate (*Punica granatum*) peel extract (PGE) is particularly rich in antioxidant compounds such as ellagitannins and polyphenols, which not only facilitate nanoparticle synthesis but also enhance their biological activity.

This study focuses on optimizing the green synthesis of AgNPs using PGE through a Box–Behnken response surface methodology (BBD-RSM) to refine key parameters for enhanced reproducibility and efficiency. The synthesized AgNPs were fully characterized, and their antimicrobial properties were evaluated.

METHODS

AgNP synthesis:



PGE characterization:

- Phenolic Content Determination
- Total Flavonoids Quantification
- High-Performance Liquid Chromatography (HPLC)
- Antioxidant determination
- Protein Quantification
- Total Reducing Sugars' Quantification

AgNPs characterization:

- Scanning electron microscopy (FESEM)
- UV-Vis Spectrophotometry
- Dynamic Light Scattering (DLS)
- Fourier Transform Infrared (FTIR) Spectroscopy
- X-Ray Diffraction Analysis (XRD)
- Antibacterial Assays

RESULTS

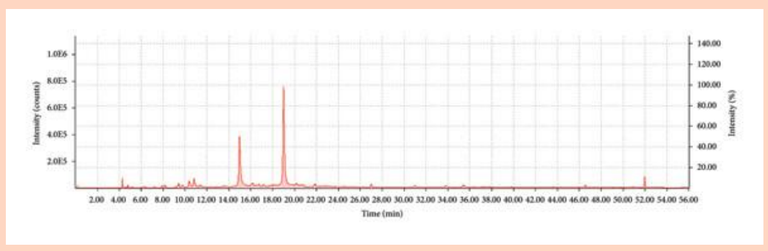


Figure 1. PGE (1mg/mL) chromatogram obtained by HPLC. Punicalagin represents 29.45 ± 1.76% w/w of total dry weight (dw).

Table 1. PGE (1mg/mL) chromatogram obtained by HPLC. Punicalagin represents 29.45 ± 1.76% w/w of total dry weight (dw).

Polyphenolic content	29.94 ± 0.36 g GA eqs/100g dw
Flavonoid content	5.15 ± 0.33 g quercetin eqs./100g dw
Antioxidant capacity	1379 ± 40 mmol TROLOX eqs./100g dw
Total reducing sugars	57.2 g glucose eqs./100g dw
Protein content	0.84 ± 0.07 g BSA eqs./100 g dw

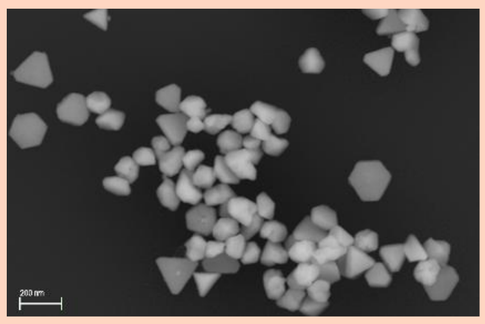


Figure 2. FESEM images of OPT-AgNPs. Scale bar: 200 nm.

AgNPs were synthesized using BBD-RSM to optimize three responses simultaneously: hydrodynamic diameter (HDD), polydispersity index (PDI) and Z-potential).

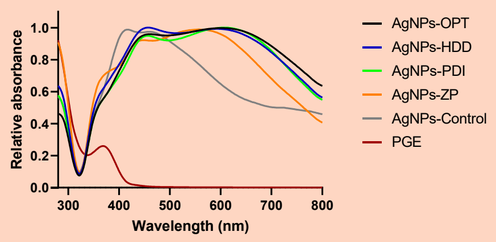
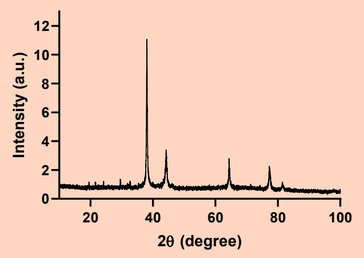


Figure 2. UV.vis spectra. CAMBIAR Y PONER SOLO 1



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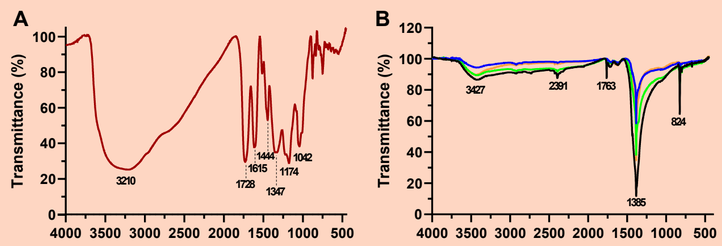

Cambiar y poner solo 1

HABLAR DE ACTIVIDAD ANTIMICROBIANA

CONCLUSIONS & FUTURE WORK

- Green synthesis of AgNPs was successfully optimized using BBD-RSM
- AgNPs optimized HDD, PDI and ZP values simultaneously.
- Characterization confirmed correct synthesis and a good fit of the BBD model.
- AgNPs exhibited antibacterial activity against E. coli and S. aureus
- Future research will focus on understanding how AgNP characteristics influence their antibacterial mechanism and refining synthesis parameters to enhance antimicrobial effectiveness.

REFS

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Para más información, colaboraciones, solicitudes de prácticas o TFG/TFM no dudes en escribirnos. Toda la información está en el QR.

DISEÑO Y VALIDACIÓN DE NANOBIOMATERIALES – DVN

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