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Eco-Friendly Synthesis of Silver Nanoparticles via Modified Tollens Reaction Using Biopolymers

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Highlights

Sustainable approach of AgNPs' synthesis under mild conditions. Alginate acts as a reducer and stabilizer for AgNPs. Optimization of synthesis conditions. NaOH and maltose affect the synthesis.

Resumo/Abstract

Silver nanoparticles (AgNPs) represent one of the most extensively studied materials in nanotechnology due to their unique physicochemical and biological properties.[1] AgNPs have been explored for a wide range of applications, including optical and electrochemical sensors for analyte detection in environmental, pharmaceutical, and food matrices, as well as for their well-known antimicrobial properties.[1,2] In this work, the influence of the concentrations of a polysaccharide, a reducing sugar, and a base on the chemical synthesis of AgNPs was evaluated through a modified version of the Tollens reaction at room temperature.

The synthesis of AgNPs followed a univariate approach, assessing the influence of sodium alginate (0 to 0,4 mg/mL) as a stabilizing agent, maltose (0 to 50 $\times 10^{-3}$ mol/L) as a reducing agent, and NaOH (0 to 50 $\times 10^{-3}$ mol/L) as a base. The concentration of $AgNO_3$ (0,2 $\times 10^{-3}$ mol/L) was kept constant in all syntheses as the metallic precursor. All reactions were carried out with a final volume of 1500 µL, varying one parameter at a time while keeping the others constant.

After 12 hours from the beginning of the synthesis, the formation of AgNPs was evaluated by UV-Vis spectroscopy in the range of 350 to 800 nm using a 5 mm optical path cuvette. It was observed that the concentration of alginate had a limited influence, with maximum wavelength (λ_{max}) values between 392 – 395 nm. On the other hand, variations in maltose (393 – 407 nm) and NaOH (406 – 412 nm) concentrations resulted in slightly more pronounced shifts in λ_{max}. Even in the absence of maltose, the formation of AgNPs was observed, suggesting that the reducing ends of alginate may promote the reduction of Ag^+ ions required for AgNP formation, thus acting simultaneously as a reducing and stabilizing agent.

According to the literature, the synthesis of silver nanoparticles mediated by alginate is commonly carried out at NaOH concentrations around 0,04 mol/L.[3] However, in the proposed methodology, it was found that the reaction can occur efficiently under milder conditions, using lower concentrations (0,01 $\times 10^{-3}$ mol/L). As the next steps, stability and morphological characterization analyses of the AgNPs will be performed to evaluate their shape and size distribution.

References

[1] KHAN, M. R. et al. Environ. Nanotechnol., Monit. Manage., 2023, 100872.
[2] MAGDY, G. et al. Microchem. J. 2024, 196, 109615.
[3] SUSILOWATI, E. et al. J. Phys.: Conf. Ser., 2021, 1912, 012016.

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