

Green Synthesis of Silver Nanoparticles and Their Antimicrobial Activity Against *Xanthomonas axonopodis* pv. *citri* (Xac)

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Silver nanoparticles (AgNP) are aggregates of elemental silver in the nanometric scale that are produced through the reduction of silver(I) ions in solution. Silver nanoparticles are well known for their antimicrobial and anti-fungal activities, what has increased the interest of researchers for these types of systems in the last few decades. AgNP can be produced by physical, chemical or biogenic methods. In this work, we present a biogenic method for AgNP synthesis using the orange (*Citrus sinensis*) peel as a source of reducing agents, along with a study of the supramolecular interactions that are involved in the stabilization of the nanoparticles. Moreover, we utilize the bioflavonoid hesperidin extracted from the orange peel to perform a green synthesis of AgNP. All the nanoparticles produced were characterized by UV-Vis spectroscopy, Dynamic Light Scattering (DLS) and Zeta potential measurements. Infrared (FTIR) spectroscopy, Raman scattering and fluorescence emission were used to study the AgNP produced from the orange peel extract in order to determine the interactions between elemental silver and biomolecules. The nanoparticles were evaluated *in vitro* in regards to their antimicrobial activity by a Minimum Inhibitory Concentration (MIC) assay against *Xanthomonas axonopodis* pv. *citri* (Xac), a microorganism that causes significant damages in the Brazilian citriculture. Low concentrations of AgNP (between 20 and 40 $\mu\text{g mL}^{-1}$) inhibited Xac growth. The nanoparticles produced were shown to be stable for over 2 months and possess a negative value of Zeta potential (between -20 and -25 mV). AgNP produced by hesperidin are no larger than 80 nm and the orange extract- produced AgNP vary in the range from 100 to 300 nm due to their biomolecules coatings. The nanoparticles synthesized presented very interesting antimicrobial activities *in vitro*, what leads to good perspectives for future *in vivo* assays in orange trees.

Keywords: *Citrus sinensis*, Silver nanoparticles, *Xanthomonas*.

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