PRODUCTION OF SILVER NANOPARTICLES USING BACTERIAL-CULTURE BROTHS OF THREE BACTERIAL ISOLATES, PHYSICO-CHEMICAL CHARACTERIZATION AND STUDY OF THEIR APPLICATIONS

Carlos Pernas, Amparo Conejo, Irma Marín y José P. Abad

Departamento de Biología Molecular, Facultad de Ciencias-Edif. Biología, Universidad Autónoma de Madrid, Cantoblanco 28049, Madrid, josep.abad@uam.es

The use of biological methods for producing nanoparticles has some drawbacks but also some advantages in respect to other methods, among the last ones for instance the lack of use of toxic chemical compounds and the possibility of applying biological diversity to produce nanoparticles with different corona composition, thus producing materials with different properties.

The work we present was centered in the synthesis of silver nanoparticles (AgNPs) by using stationary-phase bacterial-culture broths from three bacterial isolates from the Tinto River: *Pseudomonas fulva, Ochrobactrum sp.* and *Lysinibacillus sphaericus*. Culture media used were either standard nutritive medium (containing NaCl) or medium without NaCl. Primary studies by our group showed that the presence or absence of NaCl affects the synthesis process [1].

For each synthesis using different bacteria broths kinetics were analyzed and physicochemical characteristics of the AgNPs produced determined.

For each type of AgNPs, essays were performed to estimate their possible applications as antibacterials, alone or in synergy with antibiotics, by determination of the Minimal Inhibitory and Minimal Bactericidal Concentrations (MIC and MBC), and Fractional Inhibitory Concentration Index (FICI) [2] for synergy with classic antibiotics as ampicillin, nalidixic acid and streptomycin.
Also, their properties as catalyzers for discoloration of the dyes carmin indigo and bromocresol green, in oxidative or reductive degradation reactions using $K_2S_2O_8$ or $NaBH_4$ respectively, were analyzed. The efficiency of the AgNPs for detecting metal ions in aqueous solutions was also tested in terms of Limits of Detection (LOD) and Limits of Quantification (LOQ) for Hg, Cu, Cd, Ni, Pb and Zn.

The results indicate that some differences exist in the kinetics of synthesis, and physicochemical properties of the nanomaterials obtained with the different bacteria. As well, all the nanoparticles were active against the six bacteria (three gramnegatives and three grampositives) used as test for antibacterial activity, but with different efficiencies, more effective against gramnegatives than grampositives and especially effective against *Pseudomonas aeruginosa*. Synergy was also observed for some of the AgNPs with some of the antibiotics tested with best results in the case of streptomycin. Also, some nanoparticles were able to aggregate or disaggregate in the presence of metal ions, and LOD and LOQ [3] were determined, showing a particular sensitivity of the nanoparticles to the presence of Pb or Cu and less to Ni or Zn. Finally, the presence of some of the nanoparticles facilitates the degradation of the tested dyes, been very pronounced for the case of bromocresol green when oxidized with $K_2S_2O_8$.

References

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