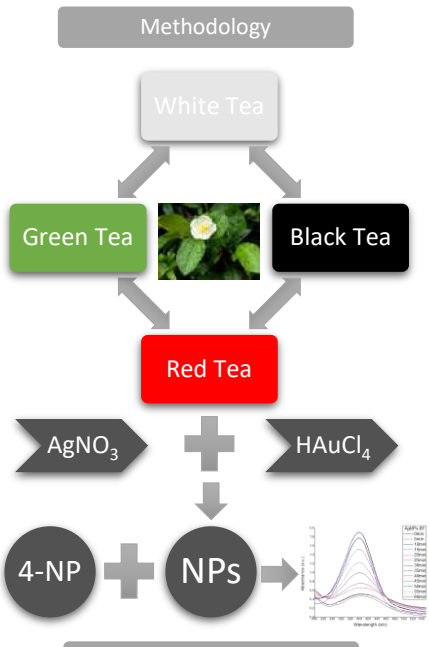
CATALYTIC REDUCTION OF 4-NITROPHENOL USING BIOGENIC GOLD AND SILVER NANOPARTICLES SYNTHESIZED BY DIFFERENT PREPARATION OF *CAMELLIA SINENSIS* EXTRACT.

Rodolfo Daniel Ávila Avilés[1,2], Alfredo Rafael Vilchis Nestor[1]

[1]Centro Conjunto de Investigación en Química Sustentable UAEM-UNAM (CCIQS), Química de Materiales, Mexico. [2]Centro de Investigación y de Estudios Avanzados del IPN - CINVESTAV, Genética y Biología Molecular, Mexico.

4-nitrophenol (4-NP) is one of the hazardous and toxic pollutants, which is known to cause adverse health effects in living organisms. 4-Nitrophenol is highly soluble and stable in water, due to its solubility traditional water purification methods as: adsorption, microwave assisted catalytic oxidation, photocatalytic degradation, electro-Fenton method and electrochemical treatment, are not so effective remove it [1]. Furthermore, all these techniques are energy-consuming and could involve the use of organic solvents. Therefore, the catalytic degradation of 4-NP assisted by noble metal nanoparticles is being explore as alternative route for 4-NP elimination. In the current study, gold and silver nanoparticles were bio-synthetized with *Camellia sinensis* extract. The effect of different commercial preparation of *Camellia sinensis* (white, black, green and red teas) over the size and shape of nanoparticles was evaluated, Au and Ag biogenic nanoparticles were employed as catalyst for degradation of 4-NP.



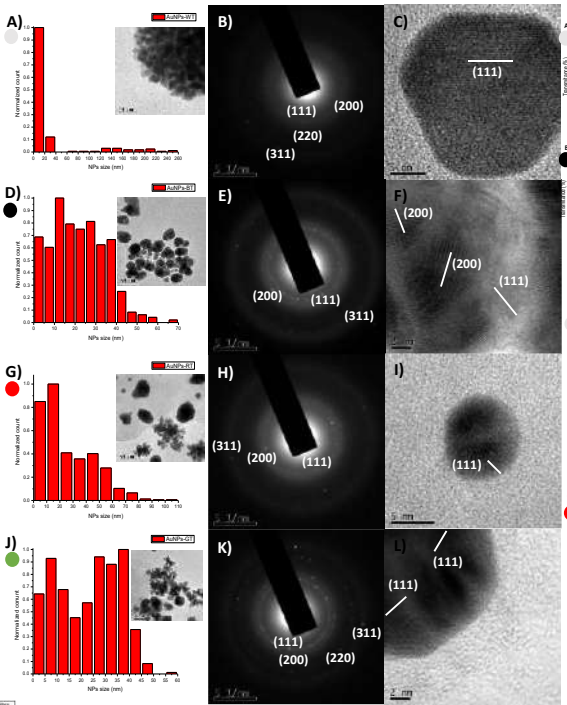


Fig. 3. TEM Characterization of biogenic gold nanoparticles using different preparations of *Camelia sinensis*. A) Histogram of size distribution of gold nanoparticles with white tea, B) HRTEM micrograph and C) SAED pattern. D-F) nanoparticles obtained by black tea extract; G-I) nanoparticles synthesized using red tea; and J-M) nanoparticles synthesized using green tea.

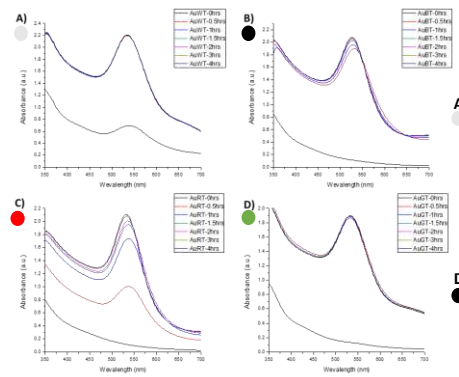


Fig. 1. UV-vis spectra of biogenic gold nanoparticles measured during the synthesis using A) white tea, B) black tea, C) red tea and D) green tea. The kinetic of the reaction was followed under the first 4 hours.

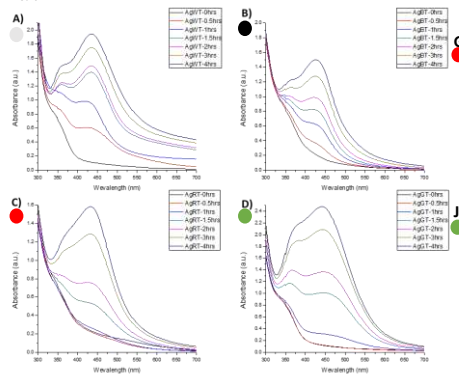


Fig. 2. UV-vis spectra of biogenic silver nanoparticles measured during the synthesis using A) white tea, B) black tea, C) red tea and D) green tea. The kinetic of the reaction was followed under the first 4 hours.

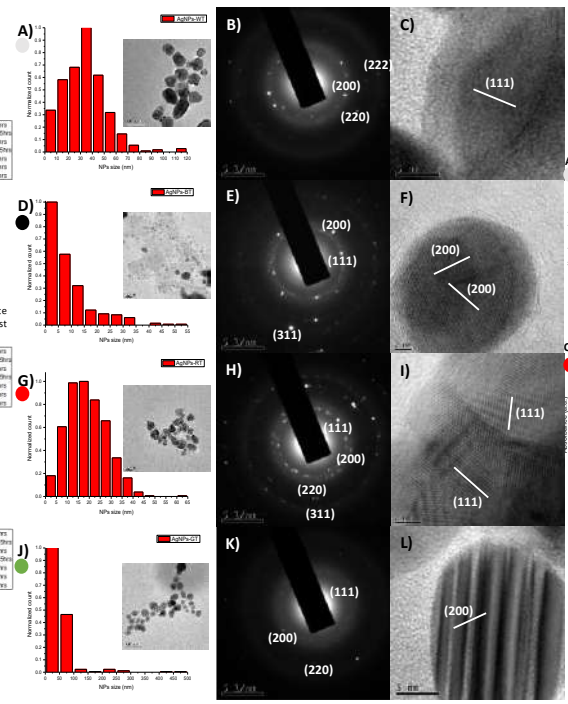


Fig. 4. TEM Characterization of biogenic spheroid silver nanoparticles using different preparations of *Camelia sinensis*. A) Histogram of size distribution of silver nanoparticles with white tea, B) HRTEM micrograph and C) SAED pattern. D-F) nanoparticles obtained by black tea extract; G-I) nanoparticles synthesized using red tea; and J-M) nanoparticles synthesized using green tea.

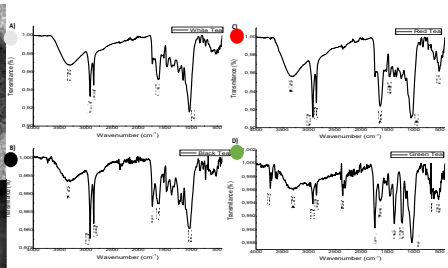


Fig. 5. FTIR spectrum of biomass from A) with tea, B) black tea, C) red tea, and D) green tea.

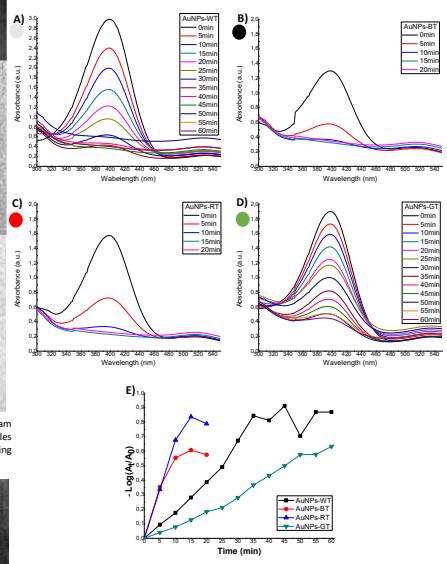


Fig. 6. A) Time-dependent UV-visible spectra for the catalytic reduction of 4-NP by $NaBH_4$ in the presence of AgNPs obtained from white tea; B) from black tea, C) from red tea and D) from green tea. E) Comparative plots of -ln (A_t/A_0) for AgNPs toward the reduction of 4-NP.

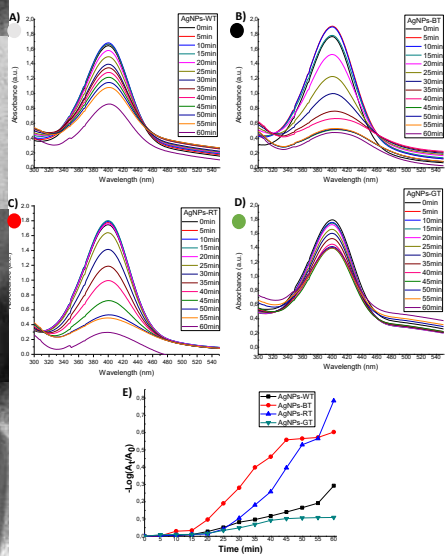


Fig. 7. A) Time-dependent UV-visible spectra for the catalytic reduction of 4-NP by $NaBH_4$ in the presence of AuNPs obtained from white tea; B) from black tea, C) from red tea and D) from green tea. E) Comparative plots of -ln (A_t/A_0) for AuNPs toward the reduction of 4-NP.

In summary, different commercial preparations of *Camellia sinensis* used to realize de extracts for the gold and silver nanoparticles synthesis; generated significances differences on polydispersity of size; mediating also the speed of the synthesis. These differences impact on the ability to realize efficient catalysis of the 4-NP reduction by NaBH4 to 4-AP in water. The catalytic efficiency of the formed AuNP is better that of AgNPs; on the other hand, the catalytic efficiency of the formed NP with red and black tea are better that of nanoparticles synthesized with white and green tea; that is associated on the size of the nanoparticles, where smaller nanoparticles enhance the catalysis assumes grater contact surface in contrast with larger nanoparticles.

1. Shin, K. S., Choi, J. Y., Park, C.S. Jang, H. J., Kim, K. Facile synthesis and catalytic application of silver-deposited magnetic nanoparticles. Catalysis Letters. (2009), 133, 1-7.