HIGH ANTIBACTERIAL EFFECT OF SILVER NANOPARTICLES PREPARED FROM AN ORGANOMETALLIC COMPOUND.

Jorge García-Barrasa,[a] José M. López de Luzuriaga,[a] Miguel Monge,[a] Yolanda Sáenz,[b,c] and Carmen Torres.[b,c]

[a]Departamento de Química. Grupo de síntesis química de La Rioja, UA-CSIC. Universidad de La Rioja. Madre de Dios 51. E-26006 Logroño, Spain.
[b]Departamento de Agricultura y Alimentación, Universidad de La Rioja, Complejo Científico-Tecnológico, Madre de Dios 51. E-26006 Logroño, Spain.
[c]Unidad de Microbiología Molecular, Centro de Investigación Biomédica de La Rioja (CIBIR). Piqueras 98. E-26006 Logroño, Spain.
Email: jorge.garcia@unirioja.es

Silver ions have long been known to have strong inhibitory and bactericidal effects, [1] however the antibacterial effect of Ag nanoparticles (NPs) has only been studied recently. The mechanism of action of the nanoparticles is not yet fully understood but it is believed that AgNPs appear attached at the bacteria cell membrane, disturbing its permeability and respiration like silver ions proceed, but whereas the silver ions coming from a salt like $AgNO_3$ show a bactericidal effect in micromolar concentrations, AgNPs show a similar effect in nanomolar concentrations.[2] In different studies it is observed a higher bactericidal effect using Ag NPs which size is in the 1–10 nm range. [3]

In order to gain more insight into this antibacterial property of AgNPs, we have prepared AgNPs in this size range (<10 nm) from organometallic compounds, like $[Ag(C_6F_5)]$. The use of these precursors allows to work under mild reaction conditions and permits a good control over the size and shape of the nanomaterials.

To control the growth of nanoparticles we use different stabilizers like long alkyl-chain amines or organic polymers. In this way, when hexadecylamine is used as stabilizer we have obtained small silver nanoparticles (~10 nm) that present an excellent antibacterial effect against *E. Coli*, *S. Aureus* and *L. Monocytogenes* bacteria.(Figure 1).[4]

When polyvinylpyrrolidone (PVP) is used as stabilizer, a polydisperse sample of silver nanoparticles displaying two size populations (~2-4 nm and ~12-15 nm) are obtained. We have checked through transmission electron microscopy (TEM) the interaction between the smaller nanoparticles and the bacteria, which does not happen with the bigger ones, proving that the higher bactericidal effect of silver nanoparticles arise from the small nanoparticles even in the presence of larger ones. We have tested these AgNPs against some usual microorganism like *E. Coli* and *S. Aureus*, and other bacteria important in food and health, obtaining very good results.

References:

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[2] C. N. Lok, C. M. Ho, R. Chen, Q. Y. He, W. Y. Yu, H. Sun, P. K. H. Tam, J. F. Chiu, C. M. Che. *J Proteome Res*. **5**, (2006), 916-924.
[3] J. R. Morones, J. L. Elechiguerra, A. Camacho, K. Holt, J. B. Kouri, J. T. Ramírez, M. J. Yacaman. *Nanotechnology*, **16**, (2005), 2346–2353.
[4] E. J. Fernández, J. García-Barrasa, A. Laguna, J. M. López-de-Luzuriaga, M. Monge and C. Torres. *Nanotechnology*, **19**, (2008), 185602 (6pp).

Figures:

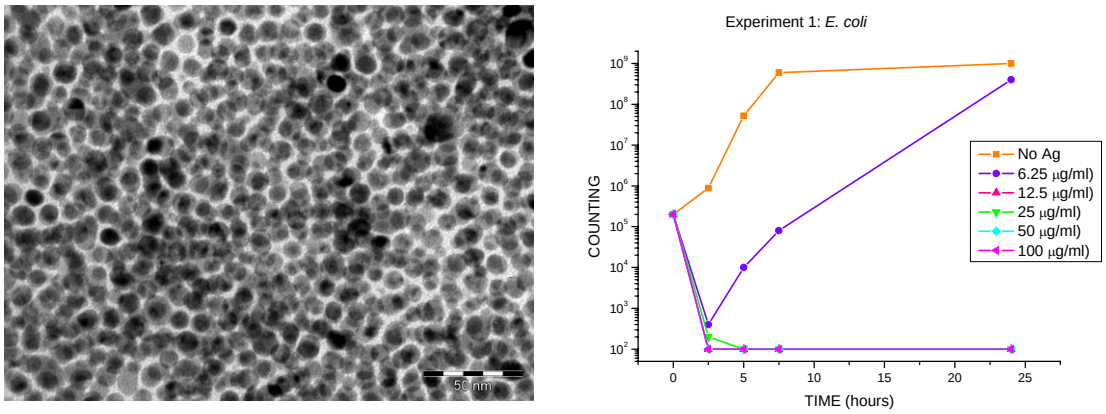

Figure 1. Silver nanoparticles obtained using hexadecylamine as stabilizing agent, and kinetic study of the bactericide effect of these AgNPs against *E. Coli*.

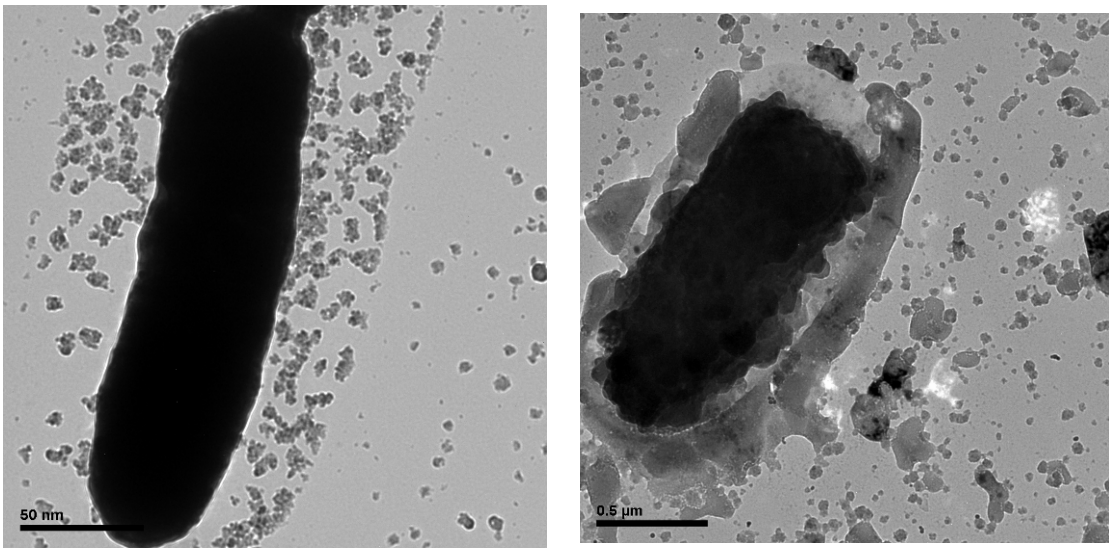

Figure 2. *E. Coli* bacterium a) without silver nanoparticles and b) with a concentration of 100 μg/mL of silver nanoparticles prepared using PVP as stabilizer.