EVALUATION OF TOXICITY ASSAYS ON AU, AG AND Fe_3O_4 NANOPARTICLES.

Joan Colón[1], Raquel Barrena[1], Eudald Casals[2], Xavier Font[1], Lucia Delgado[1], Antoni Sánchez[1], Víctor Puntes[2,3]

[1]Composting Research Group. Department of Chemical Engineering. Universitat Autònoma de Barcelona. 08193-Bellaterra. Spain.
[2]Institut Català de Nanotecnologia. Campus de la Universitat Autònoma de Barcelona. 08193-Bellaterra. Spain.
[3]Insitut Català de Recerca i Estudis Avançats. Passeig Lluís Companys, 23. 08010-Barcelona. Spain.Organization, Address, City, Country
xavier.font@uab.cat

Since society realized about the use of nanomaterials in greater quantities in consumer products and their presence in the environment, the interest on the impact of this emerging technology has grown. The main concern is whether the unknown risks of engineered nanoparticles (NPs), in particular their health and environmental impact, outweighs their established benefits for society.

Therefore, a key issue in this field is to evaluate the potential toxicity of these engineered nanomaterials. In this context we evaluated the effects on plants and microorganisms of model nanoparticles, in particular of a stable metal (Au, 10 nm mean diameter), a well known bactericide (Ag, 2 nm mean diameter) and the broadly used Fe_3O_4 (7 nm mean diameter).

Toxicity of Ag, Au and Fe_3O_4 nanoparticles was assayed by using standard toxicity tests. Specifically germination test (cucumber and lettuce), bioluminescent test (Photobacterium phosphoreum) and anaerobic toxicity tests has been performed. Germination tests were conducted at a NP dose of 62, 100 and 116 µg ml-1 for Au, Ag, and Fe_3O_4 respectively. Bioluminscent test (Photobacterium phosphoreum) was conducted at a dose of 28, 45 and 52 µg ml-1 for Au, Ag, and Fe_3O_4 respectively. Finally anaerobic tests were conducted at a NP dose of 10, 16 and 18 µg ml-1 for Au, Ag, and Fe_3O_4 respectively.

It has been observed that toxicity effects can be due to the presence of NPs solvent (stabilizers) and to the combined effect of NPs solvent and NPs. While no observed effect of NPs in the bioluminescent test, some effects were observed in the case of anaerobic bacteria (mainly in the case of NPs-solvents) and a modified root growth in the germination tests. Observed effects were either positive or negative.

In the germination tests, in some cases a slight positive effect of NPs was observed, which can be due to a hormesis effect, that is, a generally-favorable biological responses to low exposures to toxins and other stressors. Moreover, while the germination index was similar regardless of the NPs, the presence of them induced growth of larger roots as if the seeds were slightly stressed by the environment, which in the long term may be harmful, depending on the persistence of NPs in the environment.

In conclusion low or nil toxicity effect was observed for Au, Ag and Fe_3O_4 nanoparticles at the assayed concentrations. However some perturbation of the normal functions with respect to controls in germinating tests was observed, suggesting the necessity of further research in this

field. At the same time, the effect of NPs solvents (TMAOH, sodium citrate, $NaBH_4$) was in some cases more significant than that of NPs themselves, a point that is of special interest for future nanotoxicology studies.

At present, we are studying the toxicological effects of several inorganic nanoparticles using different biological tests.

Acknowledgment
The authors wish to thank the financial support received by the Spanish Ministerio de Medio Ambiente through the project NanoClean (Ref: 007/RN08/03.1). Joan Colón thanks to the Universitat Autònoma de Barcelona for the award of a pre-doctoral fellowship.