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Innovative Methodology for Extracting and Preconcentrating AgNPs from Real Samples

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Extended Abstract

Emerging nanomaterials are of great concern due to their numerous applications in cosmetic products, food technology, textiles, medical products, computing and memory devices. Silver has been extensively used as antimicrobial agent in food and beverage storage applications but also as antiseptic.

While all positive impacts of nanotechnology are extensively publicized, many critics about the potential threats to the environment and human health have just starting to emerge for the rapid growth in commercial use of metallic nanoparticles, especially silver nanoparticles, AgNPs (Wijnhoven et al., 2009; Larese et al., 2009). In vitro assays showed the high toxicity of metal nanoparticles to rat and human cells (Powers et al., 2011; Park et al., 2011, AshaRani et al., 2009).

Nowadays, there is a lack of nanoparticle monitoring data from the environment (Cayuela et al., 2014). INSTANT project (Web-1) has been created to develop a fully integrated device for monitoring the exposure of consumers to ENPs. It is funded from the European Union's Seventh Framework Programme FP7/2007-2013. One of the main objectives of INSTANT project is to improve and modify sampling and separation techniques in regard to the complex matrices. Samples with different matrices such as drinks and cosmetics are particularly challenging, specially creams for the high content of fatty compounds which requires suitable sample preparation techniques to be applied before the detection. This project involves also the preparation of NPs and standard materials (cosmetics or food matrix).

An efficient methodology for the extraction and preconcentration of AgNPs in complex matrices is presented based on the use of ionic liquid. A comparison of different types of ionic liquid reveals that imidazolium cation is fundamental for the effective extraction of AgNPs from aqueous samples by using perfluorinated anions owing to its hydrophobicity. As results shown in preliminary experiments, the selected ionic liquid in presence of the appropriate surfactant becomes excellent candidates for extracting and preconcentrating NPs of different nature from complex matrices. Nanoparticle elution was addressed by their stabilization with an amine.

Finally, the behavior of NPs before and after the extraction process was analyzed and compared by microscopic and spectroscopic techniques to guarantee no alteration of the NP size and shape either in the aggregation state. The eluted NPs were successfully quantified by capillary electrophoresis (López-Lorente et al., 2014) using a basic electrophoretic buffer to preserve NP stability. The method was validated using oil lotion with recoveries of 98-103%.

References

AshaRani P.V., Mun G.L.K., Hande M.P., Valiyaveettil S. (2009). Cytotoxicity and genotoxicity of Silver Nanoparticles in human cells, ACS Nano, 3, 279-290.

Cayuela A. Soriano, M.L., Carrión, M.C., Valcárcel, M. (2014). Functionalized carbon dots as sensors for gold nanoparticles in spiked samples: Formation of nanohybrids, Anal. Chim. Acta, 820, 133-138.

Larese F.F., D'Agostin F., Crosera M., Adami G., Renzi N., Bovenzi M., Maina G. (2009). Human skin penetration of silver nanoparticles through intact and damaged skin, Toxicology, 255, 33-37.

Park M.V.D.Z., Neigh A.M., Vermeulen J. P., de la Fonteyne L.J.J., Verharen H.W., Briedé J.J., Loveren H. van, de Jong W.H. (2011). The effect of particle size on the cytotoxicity, inflammation, developmental toxicity and genotoxicity of silver nanoparticles, Biomaterials, 24, 9810-9817.

López-Lorente Á.I., Soriano, M.L., Valcárcel, M. (2014). Analysis of citrate-capped gold and silver nanoparticles by thiol ligand exchange capillary electrophoresis, Microchim. Acta, DOI 10.1007/s00604-014-1218-5.

Powers C.M., Badireddy A.R., Ryde I.T., Seidler F.J., Slotkin T.A. (2011). Silver Nanoparticles compromise neurodevelopment in PC12 cells: Critical contributions of silver ion, particle size, coating, and composition, Environ. Health Perspect., 119 37-44.

Wijnhoven, S.W.P. Peijnenburg W.J.G.M., Herberts C.A., Hagens W.I., Oomen A.G., Heugens E.H.W., Roszek B., Bisschops J., Gosens I., Van De Meent D., Dekkers S., De Jong W.H., van Zijverden M., Sips A.A.M., Geertsma R.E. (2009) Nano-silver – a review of available data and knowledge gaps in human and environmental risk assessment. Nanotoxicology, 3, 109-138.

Websites:

Web-1: http://www.instant-project.eu/index.php?id=22 consulted 13 June 2014.