Chasing Biogenic Nanomaterials in Different Organisms by Mass Spectrometric and Other Techniques

Jörg Bettmer, University of Oviedo, Department of Physical and Analytical Chemistry, Spain.
Email: bettmerjorg@uniovi.es

Many (micro-)organisms are capable to produce biogenic nanomaterials once exposed to suitable precursors like metal ions. Their production follows a green chemistry strategy generally avoiding hazardous chemicals and harsh experimental conditions. Due to their antibiotic, anti-inflammatory and anti-cancerous activities numerous biogenic nanoparticles (NPs) have attracted great attention for their potential use in medical and pharmaceutical studies [1].

This presentation intends to give an overview on the characterisation of such biogenic nanoparticles by mass spectrometric and complementary techniques. Such characterisation requires, first, dedicated extraction methodologies that will be detailed on the example of Se NPs formed in *Saccharomyces cerevisiae* [2]. The isolated nanoparticulate fractions are further analysed by single-particle inductively coupled plasma-mass spectrometry (sp-ICP-MS) and transmission electron microscopy (TEM) as complementary tool. This strategy allowed us to characterize the present NPs in terms of shape, size and size distribution.

Two exemplary analyses will be explored in more detail: First, edible insects as organisms are analysed for the impact of present nanoparticles (in this case of Al and Fe) on the bioaccessibility [3]. Second, Se NPs are characterised in different fungi samples to explore their nature [4].

The last part of this presentation will concentrate on the analysis of the natural surface modification (in this case, the protein corona surrounding biogenic Se NPs). A dedicated combination of an extraction method [5] and liquid chromatography electrospray ionization-tandem mass spectrometry (LC-ESI-MS/MS) intends to explore the unknown composition of such proteins [4]. The results reveal the presence of multiple proteins giving hint to the formation and pathway of such nanomaterials formed in a living biological organism.

References:

[1] Suárez Priede A, Gómez-Sánchez M, García-Cancela P, Bettmer J, Díez P, *Anal. Bioanal. Chem.* **418** (2026) 415-435.

[2] Sajnóg A, Bierła K, Szpunar J, Jiménez-Lamana J, *J. Anal. At. Spectrom.* **38** (2023) 2448-2457.

[3] Machado I, Suárez Priede A, Corte Rodríguez M, Heath D, Heath E, Kouřimská L, Kulma M, Bettmer J, Montes-Bayón M, *Food Chem.* **458** (2024) 140229.

[4] LeBlanc KL, Kumlung T, Suárez Priede A, Kumkrong P, Junvee T, Deawtong S, Bettmer J, Montes-Bayón M, Mester Z, Anal. Bioanal. Chem. 416 (2024) 2761-2772.

[5] Szekeres GP, Werner S, Guttmann P, Spedalieri C, Drescher D, Živanović V, Montes-Bayón M, Bettmer J, Kneipp J, Nanoscale 12 (2020) 17450-17461.

[6] Suárez Priede A, Corte Rodríguez M, Diez García P, Bettmer J, *submitted*.