

In vitro and in vivo studies of iron oxide nanoparticles toxicity with theranostic potential

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Among the new materials exhibiting theranostic potential are undoubtedly magnetic iron oxide nanoparticles (IONPs) [1]. Due to their size, they can interact at the cellular and molecular level of biological systems. In turn, their unique magnetic properties mean that they can be used as contrast agents in MRI and as carriers for targeted drug transport, allowing for simultaneous monitoring of pharmaceutical distribution. IONPs can also induce local hyperthermia in response to an external magnetic field and thus selectively destroy cancer cells [2-5].

Extensive efforts are now underway to design IONPs with the desired physicochemical properties. However, in order to translate these theranostic nanomaterials (NMs) into clinical practice, the research aiming at determination of the biocompatibility of IONPs and the safety of their use in humans are necessary. The toxicity studies of NMs are mainly carried out *in vitro* on cell lines and cultures. *In vitro* experiments provide mechanistic information on the toxicity of NMs and, in particular, on their genotoxicity, cytotoxicity, the possibility of causing oxidative stress or the development of inflammatory processes in cells. They are, therefore, a very important step in the complex process of enhancing NMs biocompatibility and their biomedical potential [6]. However, their results cannot be directly translated into *in vivo* models, which are still crucial and mandatory before the first human studies [7-8].

The talk will present the results of own research demonstrating how the use of instrumental techniques, including the methods of atomic and molecular spectroscopy, can support the characterization of the properties of IONPs and the assessment of their toxicity and therapeutic potential *in vitro* and *in vivo* [9-12].

References:

- [1] Zhu L, Zhou Z, Mao H, Yang L (2017) *Nanomedicine (Lond)* 12:73-87. [2] Corot C, Robert P, Idée JM, Port M (2006) *Adv Drug Deliv Rev* 58:1471-1504. [3] Pankhurst QA, Connolly J, Jones SK, Dobson J (2003) *J Phys D Appl Phys* 36:167-181. [4] Dobson J (2006) *Drug Dev Res* 67:55-60. [5] Sun C, Lee JS, Zhang M (2008) *Adv Drug Deliv Rev* 60:1252-1265. [6] Dhawan A and Sharma V (2010) *Anal Bioanal Chem* 398:589-605. [7] Steger-Hartmann T and Raschke M (2020) *Curr Opin Toxicol* 23-24: 6-10. [8] Nayak R, Meerovich I, Dash AK (2019) *AAPS PharmSciTech* 20:160. [9] Matusiak K, Skoczen A, Setkowicz Z, Kubala-Kukus A, Stabrawa I, Ciarach M, Janeczko K, Jung A, Chwiej J (2017) *Nanotoxicology* 11:1225-1236. [10] Skoczen A, Matusiak K, Setkowicz Z, Kubala-Kukus A, Stabrawa I, Ciarach M, Janeczko K, Chwiej J (2018) *Chem Res Toxicol* 31:876-884. [11] Janik-Olchawa N, Drozd A, Ryszawy D, Pudełek M, Planeta K, Setkowicz Z, Sniegocki M, Zadło A, Ostachowicz B, Chwiej J (2020) *Sci Rep* 10:15447. [12] Drozd A, Matusiak K, Setkowicz Z, Ciarach M, Janeczko K, Sandt C, Borondics F, Horak D, Babic M, Chwiej J (2020) *Spectrochim Acta A Mol Biomol Spectrosc* 236:118355.

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