IMPACT OF NICKEL OXIDE NANOPARTICLES ON YEAST PHYSIOLOGY

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In the recent years, nickel oxide (NiO) nanoparticles (NPs), have been used in different fields, such as in biosensors, catalysis, ceramics, electrochromic film, electronics, conductive and magnetic materials, energy storage devices, fuel cells, printing inks and wastewater treatment [1-2]. Due to the increasing use of these NPs, concerns about their possible toxic effects have been raised. In the present study, the yeast *Saccharomyces cerevisiae* was used as a cell model to evaluate the possible hazards of NiO NPs. Physicochemical characteristics of NiO in MES buffer, namely NPs agglomeration (examined by dynamic light scattering – DLS), surface charge (determination of zeta potential) and dissolution of the NPs (quantification of Ni^{2+} released in medium) were evaluated in order to be correlated with their toxicity.

Yeast cells exposed to NiO NPs, up to 6h, in MES buffer, presented a reduced metabolic activity (evaluated by esterase activity and FUN-1 dye processing), an increased intracellular accumulation of reactive oxygen species (ROS) (quantified with 2',7'-dichlorodihydrofluorescein diacetate) and a loss of cell viability (examined by a clonogenic assay).

Dissolution studies of NiO NPs together with toxicity studies (cell viability) have shown that Ni^{2+} released by the NPs cannot explain the harmful effects observed, which means that toxicity is caused by NPs themselves. Optical and transmission electron microscopy observations of yeast cells plus energy-dispersive x-ray spectroscopy analysis have shown that NiO NPs were adsorbed onto cell surface but did not enter into yeast cells. It was proposed that NiO exert their toxic effect by an indirect mechanism: NPs adsorb to the yeast cell wall and release Ni^{2+} at the NP-yeast cell wall interface and thus enhance the toxicity. This work contributes to knowledge of the potential toxic effects of NiO NPs and to the elucidation of their toxicity mechanisms in yeasts.

[1] M. Ates, et. al., *Water, Air and Soil Pollution* **227**, 1-8 (2016).
[2] W. X. Duan, et. al., *Toxicology and Applied Pharmacology* **286**, 80-91 (2015).