Ultrastructural Characterization of MCF-7 Breast Cancer Cells Exposed to Cerium Oxide Nanoparticles Using TEM and SEM Analysis

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According to World Cancer Research Fund, breast cancer is the second deadliest malignancy in women worldwide. During the last decades, nanoparticles have received much attention due to their efficiency in cancer therapy. The antioxidative properties of cerium oxide nanoparticles (CNPs) enable cells to withstand the effects of oxidative stress, which is a hallmark of cancer. However, the mechanism of how CNPs act inside cells is so far unknown. This research aims to evaluate the internalization and possible ultrastructural modifications of MCF-7 human breast cancer cells exposed to a concentration of 300 µg/mL of CNPs using Scanning Electron microscopy (SEM) and Transmission Electron microscopy (TEM). This will be done at two different periods of time exposure; 3 days and 7 days, followed by preparing samples for both TEM and SEM imaging. The results will then be compared with non-treated samples. The findings show that it was possible to follow the fate of CNPs inside the cells and on the cellular surface. The present study suggests that the MCF-7 cells were able to internalize CNPs after 3 and 7 days inside single-membrane organelles with lysosomal characteristics. Moreover, despite the high concentration of particles used, there was a weak evidence of mitochondrial shrinkage after 3 days, with no significant changes in cell morphology. Further investigations, including studies on uptake kinetics and intracellular trafficking combined with biological assays, could help to better characterize the effects of internalized nanoparticles as potential tools for biomedical applications.