INTERNALIZATION AND LOCALIZATION OF QD IN CACO-2 CELLS USING 2-PHOTON-MICROSCOPY

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Engineered nanomaterials (ENMs) are promising tools for various commercial applications including biomedical applications. In order to design safe ENMs, it is necessary to identify nanoparticle properties influencing the interactions between nanoparticles and cells. Quantum dot (QD) nanocrystals have great potential in nanomedicine as tools for bioimaging because of their unique fluorescent properties. But the possible toxicity in regard to their chemical composition and their cellular distribution are still under investigation.

In this in vitro study, we exposed Caco-2 cells as a model for the small intestine with different surface coated QD (NH2, COOH and PEG) of 15 nm primary particle size (TEM). Cells were incubated with a non-cytotoxic concentration for 1 and 3 days and the nucleus (Hoechst) as well as the membrane (WGA-Tetramethylrhodamine) were stained. Two-photon and confocal microscopy were used to obtain 3D image stacks which were deconvolved using Huygens Professional.

The obtained z-stacks were used to determine the relative penetration depth of QDs into the cell lumen of differentiated compared to undifferentiated cells. The presented studies showed that the uptake frequency of the used QDs depends on the differentiation status of the Caco-2 cells. In undifferentiated cells, QD-NH2 and QD-COOH could penetrate deeper into the cell lumen. On the other hand, in differentiated Caco-2 cells QD-NH2 and QD-COOH were only detected directly below the membrane and did not penetrate deep into the cytoplasm. QD-PEG could not be detected intracellularly in undifferentiated as well differentiated cells. In comparison to QD-COOH the QD-NH2 formed larger aggregates on the cell membrane which could also be detected intracellularly.

The results so far show, that the differentiation status of the Caco-2 cells as well as the surface modifications have a great influence on the uptake frequency of QD in enterocytes. Furthermore, co-localization studies of QDs with different intracellular components of the endocytotic pathway like early or late endosomes are under investigation.