Hazard Assessment of New Food Technology-based Block Copolymers and Silicon Nanoparticles

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The objective of the present project is to develop new biofunctional and biocompatible nanoparticle (NP) delivery systems with improved bioavailability for functional food ingredients (flavonoids) and to provide mechanistic insight in the bioavailability, biocompatibility and toxicity of these new bionanoparticles as a function of their molecular characteristics. This in order to facilitate future development of these NPs and judgement of their biofunctionality and biocompatibility, thus enabling new bionanotechnology applications and their proper risk assessment in the field of food technology and food safety.

NPs of cross-linked amphiphilic block copolymer (ABC) micelles and functionalized silicon NPs, which have sizes in the 1-100 nm range, were studied for their toxicity in vitro using Caco-2 enterocytes. Cytotoxicity of the cross-linked ABC-micelles and amine- and carboxyl-terminated silicon NPs were studied in the MTT and BrdU assay. Furthermore the effect of ABC-micelles (cross-linked Pluronics) on apoptosis was tested in Caco-2 cells using the caspase-3 assay. Pluronic micelles showed a very low cytotoxicity and had no effect on apoptosis. Amine terminated silicon NPs were toxic and inhibited cell proliferation at low doses (ED_{50}: 0.8-2 nM), while carboxyl terminated particles were almost not cytotoxic in Caco-2 cells. It is suggested that the surface charge in these uniform-sized silicon NPs plays a role in their toxic properties.