Role of the crystalline form of titanium dioxide nanoparticles: Rutile, and not anatase, induces toxic effects in Balb/3T3 mouse fibroblasts

Abstract:
The wide use of titanium dioxide nanoparticles (TiO2 NPs) in industrial applications requires the investigation of their effects on human health. In this context, we investigated the effects of nanosized and bulk titania in two different crystalline forms (anatase and rutile) in vitro. By colony forming efficiency assay, a dose-dependent reduction of the clonogenic activity of Balb/3T3 mouse fibroblasts was detected in the presence of rutile, but not in the case of anatase NPs. Similarly, the cell transformation assay and the micronucleus test showed that rutile TiO2 NPs were able to induce type-III foci formation in Balb/3T3 cells and appeared to be slightly genotoxic, whereas anatase TiO2 NPs did not induce any significant neoplastic or genotoxic effect. Additionally, we investigated the interaction of TiO2 NPs with Balb/3T3 cells and quantified the in vitro uptake of titania using mass spectrometry. Results showed that the internalization was independent of the crystalline form of TiO2 NPs but size dependent, as nano-titania were taken up more than their respective bulk materials. In conclusion, we demonstrated that the cytotoxic, neoplastic and genotoxic effects triggered in Balb/3T3 cells by TiO2 NPs depend on the crystalline form of the nanomaterial, whereas the internalization is regulated by the particle size.

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