The Effect of Silicon Quantum Dots in liver of Swiss Albino Mice

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QDs are semiconductor fluorescent nanocrystals comprising elements of groups II-VI, III-V or IV-VI of the periodic system, e.g. Cadmium telluride (Group II and Group VI Te Group VI) or indium fosampamide (Group III and Group P Group V). They have diameters between 2 and 10 nm and contain about 200 to 10,000 atoms. In general, QD consists of an inorganic CdTe or CdSe semiconductor material, and a coating of another semiconductor material, eg ZnS. It is covered with an organic layer soluble in aqueous solvents, on the surface of which biomolecules can be conjugated.

Choosing the coating and the organic layer is essential for stabilizing the crystalline core, modifying photophysical properties as well as controlling / reducing toxicity. When the semiconductor materials are on a human scale, their electrons possess different energy states that can be described as a continuous magnitude. At the nanoscale, these energy states become discrete due to the effects of quantum limitation. Spectra of organic dyes can overlap - limiting the number of dyes that can be used in an experiment. QD emission can be controlled by the size of the composition and the surface coating - Multiplex imaging. Organic dyes lose fluorescence within minutes of exposure to light. QD are very stable due to the inorganic core. QD can be used in repeated excitement-emission cycles and keeps the intensity of light for several hours.QDs emit more intense fluorescence light in aqueous solutions than organic dyes.

Quantum dots have been recently tested for biological applications such as cancer therapy, cellular imaging and drug delivery.

Aim:

The purpose of this study was to evaluate in vivo the degree of oxidative stress generated at the liver level following administration of Si / SiO2 QDs.

Materials & Methods

Silicon QDs toxicity was investigated by injection into the codified vein of these Si / SiO2 QDs in Swiss mice, being tested in 3 different concentrations (1, 10 and 100 mg QDs / kg body weight). After 24 hours of nanoparticle administration, the mice were sacrificed and liver tissue was sampling.

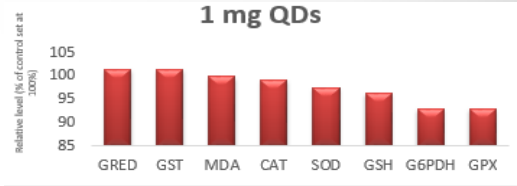
From the total protein extracts, were measured the specific activities of the antioxidant enzymes (superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPX), glutathione reductase (Gred), glutathione S-transferase (GST), glucose 6-phosphate dehydrogenase (G6PDH), as well as reduced glutathione (GSH) and malonaldehyde (MDA) concentration, the results have been reported to mice injected with phisiological serum.

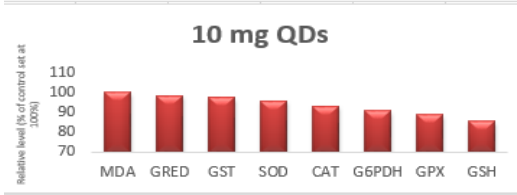
Results & Discussion

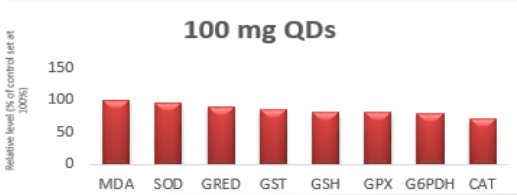
The analyzes showed that the first two concentrations of tested nanoparticles (1 and 10 mg QDs / kg body) did not induce liver toxicity, the values being obtained nearby the control. Regarding the highest dose (100 mg QDs / kg body weight), 30% decrease in CAT activity, 22% G6PDH activity, 15% GST activity, and 20% GPX and GSH concentration..

Conclusions

The determinations performed demonstrate the lack of toxicity of Si / SiO2 QDs to concentrations of 10 mg/kg body, not affecting the redox balance at the liver. The results of this study shows experimental evidences with high importance to the study of in vivo use of materials based of quantum dots in various medical fields.







Decrease in CAT activity could be attributed to an increased flow of superoxide radicals that inhibit CAT. G6PDH affects GPX, GRED, and GSH synthesis.

At low GSH concentrations, cytosolic GST is inhibited by the binding of alpha, beta-unsaturated carbonyl derivatives to specific cysteine residues of the enzyme.

GPX mainly catalyses the direct reaction of GSH with ROS, such as hydrogen peroxide and lipid peroxides