# DEXTRAN COATED CERIUM OXIDE NANOPARTICLES ACT AS ANTIOXIDANTS

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**Statement of Purpose:** The aim of this study was to evaluate the potential use of the antioxidant activity of surface -modified cerium oxide in rescuing human dermal fibroblast cells in the presence of hydrogen peroxide ($H_2O_2$) or hydroquinone (HYQ). It is widely known that various stressors like UV, heavy metals, drugs and other environmental agents constantly challenge cells. If unchecked, these stressors lead to diseases including inflammation, premature aging, neurodegeneration, various other disorders, and cancer. Oxidative stress is responsible for generating various types of reactive oxygen species (ROS), such as the superoxide anion ($O_2^-$), the hydroxyl radical (OH) and $H_2O_2$. ROS scavengers have become an important area to focus on nano-technology and apply to nano-medicine. Recently, many research groups have started to investigate the potential of nano-scaled materials with antioxidant properties like rare earth oxide nanoparticles, fullerenes and carbon nanotubes. With recent reports on cerium oxide nanoparticles being neuroprotective, radioprotective and anti-inflammatory, cerium oxide nanoparticles may be potential free radical scavengers which allow us to use it as a therapeutic agent to fight against cancer and other diseases due to a reduction in ROS. Considering these facts, cerium oxide nanoparticles may promote cell survival under oxidative stress

**Methods:** Ceria nanoparticles were synthesized from 1 mL aqueous solutions of 1 M cerium nitrate (Sigma Aldrich, St Louis, MO) and 2 mL of 0.1 M dextran T-10 (Pharmacosmos, Holback, Denmark) and these solutions were added drop wise to 6 mL of a 30% ammonium hydroxide (Sigma Aldrich, St. Louis, MO) solution while stirring for 24 hours at 25 °C.. Cytotoxicity (MTS) assays were also carried out with human dermal fibroblast (ATCC® PCS-201-012™) cells for 1 day in culture using DMEM (ATCC® 30-2003™), 10% FBS (ATCC® SCRR-30-2020™) and a 1% penicillin-streptomycin solution (ATCC® 30-2300™). Cells were seeded at a density 5,000 cells/well, allowed to adhere for 24 hours and the following day, the culture was treated with cytotoxic agents like hydrogen peroxide ($H_2O_2$) or hydroquinone (HYQ) with the concentration range from 100 to 800µM. After 24 hours of incubation, the MTS reagent was added and was determined

**Results:** Synthesized nanoparticles were characterized in terms of their size and distribution via Transmission Electron Microscopy (TEM) and Dynamic Light Scattering (DLS). TEM and DLS results showed that the particles were around 3 nm and DLS results confirmed that there was no significant change in the size of the particles when they were stored in +4 °C over two months. The chemistry of the particles was analyzed via X-ray photoelectron spectroscopy (XPS). XPS data indicated the presence of cerium atoms in dried powdersA dose of 500µM for $H_2O_2$ and 150µM HYQ cytotoxic agents was found effective in killing 50% of the cells. In order to determine the cyto-protective function of ceria nanoparticles, some of these cells were preincubated with ceria at a 500µg/mL concentration for 24 hours followed by the addition of cytotoxic agents. The culture was incubated for 24 hours before MTS assays. Results were compared with only 500µM of $H_2O_2$ and 150µM HYQ, but not ceria treated cells.

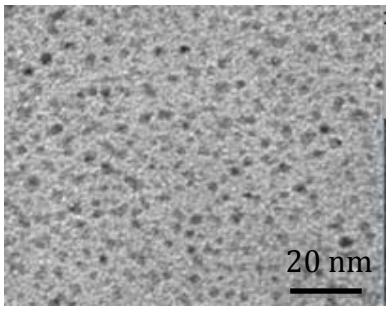


Figure 1. TEM micrograph of 0.1 M Dextran Coated Ceria Nanoparticles

**Conclusions:** Sub 5 nm dextran coated ceria nanoparticles were synthesized and cultured with HDF cells which were treated by cytotoxic reagents. The results showed that ceria treated cells were able to recover from the oxidative damage /cytotoxicity exerted by the drugs which suggests that ceria nanoparticles may act as antioxidants within the body.

**References:**

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