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Concentration dependent internalization and toxicity of iron oxide nanoparticles

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Ever since the nanotechnology and materials science have emerged, the application of nanomaterials have increased exponentially in many fields including medicine, pharmaceuticals, cell sorting, hyperthermia, cosmetics, or combinations of multiple applications. Iron oxide nanoparticles (IONPs) in particular are increasingly used in medical applications, such as drug delivery, imaging, magneto-fection, tissue repair, cellular therapy and cell labelling. However, toxicity of the IONPs has not been fully elucidated. Hence the present study is aimed to explore the possible interaction of iron oxide nanoparticles and its toxicity on splenic lymphocytes of male Wistar rat. To address the issue we have selected and characterized iron oxide nanoparticles. The average hydrodynamic diameter and shape of nanoparticles were ~35 nm and spherical respectively. Lymphocytes were treated with different concentration of IONPs for different time intervals (24 and 48 h). Exposure of cultured rat's lymphocytes with IONPs showed a time and concentration dependent uptake of the particles, as demonstrated by transmission electron microscope and elemental mapping (TEM-EM). Higher concentration and longer duration of exposure altered cell viability. TEM images and elemental mapping revealed the adherence of the IONPs to the cell membrane as well as internalization and accumulation in the intracellular vesicles. As the concentration and time increase, densely packed large vesicles were formed in the lymphocytes. In addition, longer period of incubation induced oxidative damage in lipid and DNA. The observation suggests that endocytotic process may involve in uptake which lead to cellular damage.

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A bio-comparative study of copper nanoparticles synthesized by using different reducing agents

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In the present study, Copper Nanoparticles (Cu NPs) were prepared by reduction of Copper Nitrate ($CuNO_3$) using three reducing agents viz. Sodium Borohydride (SBH), tri-sodium citrate (TSC) and Oxalic Acid (OA). In every experiment, copper nitrate and reducing agent were taken in 1:1 ratio. The concentrations of copper nitrate and reducing agents used are in the range of 0.02-1.0M. The synthesized Cu NPs were characterized by UV-visible spectroscopy, particle size analysis, x-ray diffraction, SEM/FESEM with EDAX and zeta potential. UV-visible spectroscopy revealed a typical Surface Plasmon Resonance (SPR) in the range of 228-320nm. The size of copper nanoparticles, as determined by the particle size analysis, is seen to be 37nm when SBH was used as reducing agent, 14nm when TSC was used as reducing agent and 46nm when OA was used as reducing agent. The shape of the Cu NPs was found to be reducing agent dependent. Snowflake shaped Cu NPs were obtained when SBH was used as reducing agent, hollow tubes/rod shaped Cu NPs were obtained when TSC was used as reducing agent and ellipsoid/rice-grain shaped Cu NPs were obtained when OA was used as reducing agent. XRD and SEM-EDAX patterns indicated the presence of copper along with oxygen as an impurity. The antibacterial activity of Cu NPs dispersion was measured by the Kirby Baeur method. The Cu NPs synthesized by using 3 reducing agents using six different concentrations showed varied antibacterial activity against gram+ve and gram–ve bacteria's.

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