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Cytotoxic and Genotoxic Effect of Iron Oxide (Fe_2O_3) Nanoparticles on *Allium Cepa*

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Abstract: This study aims to examine the cytotoxic and genotoxic impacts of iron oxide (Fe_2O_3) nanoparticles (NPs) using an indicator organism, *Allium cepa.* Four concentrations (125, 250, 500, and 750 µg/mL) of Fe_2O_3 NPs were applied to *Allium* bulbs for 24 hours. While all the concentrations used induced a significant reduction in the mitotic index, they induced significant and dose-dependent increase in chromosome abnormalities compared to control. The common aberrations observed were C-metaphase, disturbed prophase, metaphase, and ana-telophase. Laggard chromosomes and chromosome bridges were also observed. NPs may produce reactive oxygen species (ROS) and thereby leads to cell damage and even cell death. This study showed that Fe_2O_3 NPs have cytotoxic and genotoxic potential in *Allium cepa* root tip cells. These data provide valuable information for further research on their phytotoxic mechanisms.

Keywords: Fe_2O_3 nanoparticles, *Allium cepa*, Genotoxicity, *Allium* Test
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Iron oxide (Fe_2O_3) nanoparticles (NP) are currently used in biomedical applications such as tissue repair, immunoassay, detoxification of biological fluids, cell separation, magnetic resonance imaging, and drug transport [1]. However, some researches in recent years show that Fe_2O_3 NPs can be cytotoxic and genotoxic. Therefore, in this study, four concentrations (125, 250, 500, and 750 µg/mL) of Fe_2O_3 NPs (<50 nm) were administered to onion root tips for 24 hours by using Yuzbasioglu et al.'s method [2] with some modifications. Distilled water and H_2O_2 were used as negative and positive controls, respectively. Compared to the negative control, all the concentrations of Fe_2O_3 NPs significantly decreased the mitotic index and increased the frequency of chromosomal abnormalities (Figs. 1-3) dose-dependently. These results show that Fe_2O_3 NPs have genotoxic effects in *Allium cepa* root tip cells. However, more and detailed genotoxicity studies should be conducted in different cell types and organisms for the safe usage of NPs.



Figure 1. *Stickiness at metaphase*

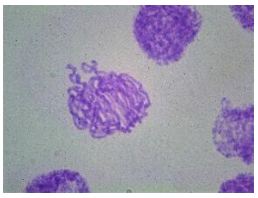


Figure 2. *Disturbed prophase*

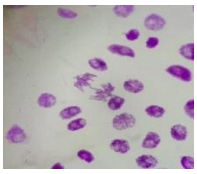


Figure 3. Chromosome bridges *at anaphase*

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