Zinc oxide nanoparticles-mediated changes in ultrastructure and macromolecules of pomegranate callus cells

Abeer A. Radi· Fatma A. Farghaly· Fatma A. Al‐Kahtany· Afaf M. Hamada

Abstract:

The dramatic increase in the usage of nanoparticles (NPs) in a variety of applications extensively expanded the possibility regarding the release of NPs into our ecosystem. Pomegranate is a tropical and subtropical countries‐ shrub, as offers food supplement and more pharmaceutical and medicinal applications. Here, we investigated the effects concerning different concentrations regarding each of ZnO NPs and its bulk on growth, uptake of Zn, potassium (K), phosphorus (P), proline, ascorbic acid, total phenolic compounds, total antioxidant, localization of Zn in callus cells by transmission electron microscope (TEM) and changes in macromolecules by Fourier transform infrared spectroscopy (FT-IR) in pomegranate (Punica granatum cv. Hegazy) callus. Growth parameters in callus exposure to high concentrations of ZnO (50‐200 μg mL‐1) were reduced. Different concentrations of ZnO NPs and bulk did not affect the content of K and P. In comparison according to control, uptake of Zn was increased in pomegranate callus exposed to both ZnO NPs and its bulk. Moreover, TEM images showed small cells with the tortuous cell wall, disintegrated cytoplasmic content and Zn deposition in the cell walls at low concentration of ZnO NPs. However, the high concentration of ZnO NPs showed a further Zn influx in the cytoplasm and attachment to the tonoplast. The FT-IR analysis confirmed variations in the peaks corresponding to the most macromolecules, phenolic compounds, lipids, proteins, carbohydrates, cellulose, and hemicellulose. From these results, we could consider the toxicity effects concerning ZnO NPs and its bulk.

Keywords:

Zinc oxide nanoparticles · Pomegranate · Transmission electron microscopy · Fourier transform infrared

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