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Moringa seed extract alleviates titanium oxide nanoparticles (TiO2-NPs)-induced cerebral oxidative damage, and increases cerebral mitochondrial viability

Abstract To investigate the influence of Moringa seed extract (MSE) on the cerebral Nrf2/NQO1 signaling in TiO2-NPs–induced brain damage, 80 male albino rats were divided into four groups (n = 20); group I was used as a control, group II received TiO2-NPs (500 mg/kg b.w/day orally) for 14 days, group III received MSE (100 mg/kg b.w/day orally) for 30 days, and group IV received MSE an hour before TiO2-NPs administration with the same doses as before. Administration of TiO2-NPs was started on the 17th day for both groups (II) and (IV). Administration of MSE significantly increased the cerebral mitochondrial viability and Nrf2 level with a simultaneous increase of NQO1 mRNA expression. This designates a powerful antioxidant effect of MSE which is indicated by a significant reduction of INOS expression, MDA, TOS, OSI levels, and DNA fragmentation % with a significant increase of GSH concentration, SOD activities, and TAC. MSE possesses an anti-inflammatory effect by a significant reduction of IL-1β and TNF-α levels, and anti-apoptotic effect manifested by a significant reduction of caspase-3 and Fas levels. In harmonization, dopamine, serotonin concentrations, and acetylcholinesterase activities return back to normal as compared to control group. These results were confirmed by the histopathological features which were alleviated with MSE administration. In conclusion, Nrf2 plays a pivotal role in the mechanism of TiO2-NPs cerebral toxicity and MSE as a Nrf2 activator can provide a powerful cerebroprotective effect, whereas MSE increased the Nrf2 expression and consequently restore the antioxidant activity of brain cells by increasing NQO1 gene expression and cerebral mitochondrial viability as well as inhibition of pro-inflammatory and apoptotic mediators.
Keywords TiO2 nanoparticles . Moringa . Brain . Antioxidant . Apoptosis . Nrf2 . NQO1