

Cytotoxic effect of magnetic iron oxide nanoparticles synthesized via seaweed aqueous extract

ABSTRACT

Magnetic iron oxide nanoparticles (Fe₃O₄ MNPs) are among the most useful metal nanoparticles for multiple applications across a broad spectrum in the biomedical field, including the diagnosis and treatment of cancer. In previous work, we synthesized and characterized Fe₃O₄ MNPs using a simple, rapid, safe, efficient, one-step green method involving reduction of ferric chloride solution using brown seaweed (*Sargassum muticum*) aqueous extract containing hydroxyl, carboxyl, and amino functional groups mainly relevant to polysaccharides, which acts as a potential stabilizer and metal reductant agent. The aim of this study was to evaluate the *in vitro* cytotoxic activity and cellular effects of these Fe₃O₄ MNPs. Their *in vitro* anticancer activity was demonstrated in human cell lines for leukemia (Jurkat cells), breast cancer (MCF-7 cells), cervical cancer (HeLa cells), and liver cancer (HepG2 cells). The cancer cells were treated with different concentrations of Fe₃O₄ MNPs, and an MTT (3-[4,5-dimethylthiazol-2-yl]-2,5 diphenyl tetrazolium bromide) assay was used to test for cytotoxicity, resulting in an inhibitory concentration 50 (IC₅₀) value of 23.83±1.1 µg/mL (HepG2), 18.75±2.1 µg/mL (MCF-7), 12.5±1.7 µg/mL (HeLa), and 6.4±2.3 µg/mL (Jurkat) 72 hours after treatment. Therefore, Jurkat cells were selected for further investigation. The representative dot plots from flow cytometric analysis of apoptosis showed that the percentages of cells in early apoptosis and late apoptosis were increased. Cell cycle analysis showed a significant increase in accumulation of Fe₃O₄ MNP-treated cells at sub-G1 phase, confirming induction of apoptosis by Fe₃O₄ MNPs. The Fe₃O₄ MNPs also activated caspase-3 and caspase-9 in a time-response fashion. The nature of the biosynthesis and therapeutic potential of Fe₃O₄ MNPs could pave the way for further research on the green synthesis of therapeutic agents, particularly in nanomedicine, to assist in the treatment of cancer.

Keyword: Green synthesis; Seaweed water extract; Anticancer effect; Apoptosis