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