Phytoreductive-Hydrothermal Synthesis of Polyethylene Glycol-coated Magnetic Iron Oxide Nanoparticles for Drug Delivery Applications

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Iron oxide nanoparticles (IONPs) can facilitate the delivery and sustained release of therapeutic agents to target sites of action, but conventional techniques to synthesize IONPs use highly reactive solvents, expensive and specialized equipment and produce potentially hazardous by-products. This study aimed to use phytoreduction with hydrothermal treatment as an alternative approach in the synthesis of IONPs.The leaf extract of Chromolaena odorata was used as a reducing, capping and stabilizing agent. The extract was combined with anhydrous ferric chloride, and treated in a hydrothermal reaction vessel. The IONPs produced were coated with polyethylene glycol for the entrapment of a model drug - ciprofloxacin. UV-visible spectrophotometry showed absorbance peaks at 322 nm and 271 nm attributable to pegylated IONPs and the entrapment of ciprofloxacin. The diameter (18.12 ± 1.44 nm) and quasi-spherical shape of PEG-IONPs determined by Atomic Force Microscopy suggests that it can traverse intracellular spaces and ultra-small capillaries. In vitro release tests demonstrated ciprofloxacin incorporation with an encapsulation efficiency of 76.49 ± 1.24 %. The system exhibited controlled release, sustaining the liberation of 56.02 ± 3.75 % of the drug over a 120-minute observation period. Broth microdilution assay determined system MIC at 2.35 and 4.7 µg/mL for E.coli and S.aureus, respectively, confirming that the therapeutic effect of the drug was uninhibited by encapsulation procedures. The study showed that the phytoreductive-hydrothermal method is a viable alternative for the production of IONPs.

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