North-East Research Conclave

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Track: SE

Green synthesized Iron oxide nanoparticles using leaf extract of *Camellia sinensis var. assamica* for the reduction of hexavalent chromium

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Abstract

The chemical synthesis of nanoparticles (NPs) is done in the presence of different reactive and toxic chemicals such as borohydrates and hydroxides, which cause innumerable impacts on the surrounding environment, animal, and plant life [1]. Hence, there is a vital requirement of environment-friendly methods for the synthesis of NPs. Polyphenolic (PPs) constituent of plant extracts has been the area of prime interest due to their congenital chemical characteristics. PPs constitute a broad range of biomolecules ranging from alkyl aldehydes to alcohols. These biomolecules have been used as reducing agents by various researchers for the synthesis of mostly metal and metal oxides NP [2]. In the present study, Iron oxide nanoparticles (IONPs) were successfully synthesized using leaf extract of *Camellia sinensis var. assamica* as a sole reducing agent and explored for the reduction of hexavalent chromium. The prepared 100 g/L of *Camellia sinensis var. assamic* dried leaf extract was quantified for Epigallocatechin gallate (ECGC), Total phenolic content (TPC), Total flavonoid content (TFC), Ferric reducing power (FRAP), Scavenge free radicals (SFR) and Superoxide radical scavenging (SRSA) (Pyrogallol) activity, respectively. The synthesis of IONPs were optimized by Response Surface Methodology-Central Composite Design (RSM-CCD) and reaction parameters explicitly time (30 - 150 minutes), temperature (25 - 85°C), and Iron precursors to leaf extract ratio (0.3 - 1 v/v) were chosen with absorbance at 277nm as the response. Further, the synthesized IONPs were characterized for physicochemical properties by using Field Emission Scanning Electron Microscope (FESEM), Ultraviolet–visible spectroscopy (UV-Vis), Dynamic Light Scattering (DLS), zeta potential, X-ray powder diffraction (XRD), Energy dispersive X-ray spectroscopy (EDX), and Brunauer–Emmett–Teller (BET) Surface Analyzer. The quantification of tea leaf extract showed 929.2 ± 10.8 µg/mL, 2532

± 28 gallic acid equivalent , 353.44 ± 12.12 quercetin equivalent (QE), 6755.55 ± 80.12 QE, 27.88 ± 8 ascorbic acid equivalent (AAE) and 6718.51 ± 84.13 AAE content of ECGC, TPC, TFC, FRAP, SFR and SRSA, respectively. Moreover, the synthesis of IONPs was done at RSM optimized conditions with minimum absorbance at 277nm and applied for the adsorptive reduction of hexavalent chromium (Cr(VI)) from an aqueous solution. The synthesized IONPs as shown in figure 1(A) revealed maximum and minimum % Cr(VI) removal at pH 2 (97%) and pH -10 (24%), respectively with temperature of 25°C, and the dosage of 1 g L^{-1} from 40 ppm aqueous solution. Furthermore, rapid adsorption of Cr(VI) over IONPs took place within initial 45 minutes (95%) (Figure 1(B)) at pH-2 and reached equilibrium in 180 minutes.

Keywords: *Green synthesis; Metal oxide NPs; Adsorption; Heavy metal removal*

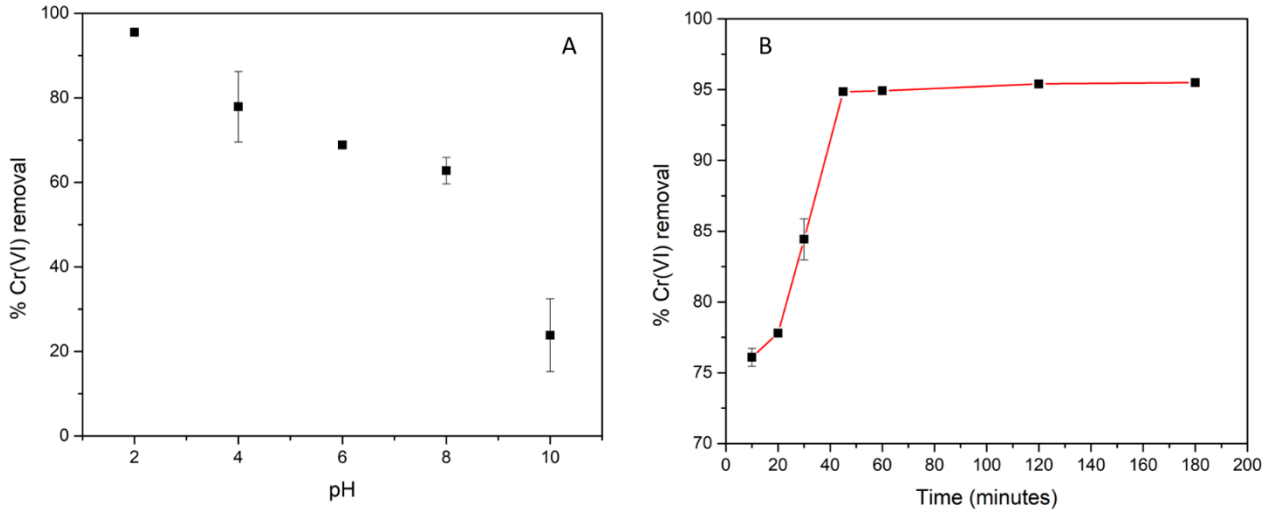

Figure 1: Effect of (a) pH and (b) time on % Cr (VI) removal by using synthesized IONPs

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