







# Rapid green-assisted synthesis and functionalization of superparamagnetic magnetite nanoparticles using *Sumac* extract and assessment of their cellular toxicity, uptake, and anti-metastasis property

Farhank Saber Braim<sup>a b c</sup>  , Nik Noor Ashikin Nik Ab Razak<sup>a</sup>  , Azlan Abdul Aziz<sup>a b</sup>,  
Mohammed Ali Dheyab<sup>a b</sup>, Layla Qasim Ismael<sup>b d</sup>

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## Abstract

Modifying the surface properties of superparamagnetic magnetite nanoparticles (SPMNPs) is essential for their stabilization and functionalization in biomedical applications. This study explored the use of Sumac (*Rhus coriaria*) plant extract as a green stabilizer for SPMNPs. Herein, we fabricated the aqueous colloidal suspension of SPMNPs via a facile and rapid green-assisted co-precipitation method using the extract solution as a green stabilizer ( $S_S$ ), the results were then compared to the uncoated SPMNPs ( $S_B$ ). Physicochemical properties of the as-synthesized NPs were characterized. The XRD planes of both samples matched the typical  $Fe_3O_4$  NPs with a high degree of crystallinity. FESEM and TEM revealed that  $S_S$  were spherical and mono-dispersed with an average particle size of 11 nm, while the average particle size of  $S_B$  was measured to be around 9.9 nm. The elemental compositions of the  $S_S$  were approved by the EDX technique. FTIR and TGA results confirmed the presence of functional groups in the extract components and their interactions with SPMNPs. Based on the DLS analysis, *Sumac* extracts significantly prolonged the stability and increased the zeta potential value of the SPMNPs nanofluid from  $-28.2$  to  $-44.8$  mV. The magnetization ( $M_s$ ) values of  $S_B$  and  $S_S$  samples were found to be 62.95 emu/g and 139.56 emu/g, respectively. VSM results pointed out that *Sumac* extracts dramatically enhanced the saturation magnetization of the coated SPMNPs. In vitro cytotoxicity and scratch assays of the  $S_S$  against MCF-7 cells indicated the non-toxicity, proliferation modulation, and growth inhibition abilities (anti-metastatic properties) of the modified NPs. In addition, the cellular uptake assessment of  $S_S$  on the MCF-7 cancer cell line revealed a dose-dependent internalization. Our findings implied that this hydrophilic, highly magnetic, stable, and biocompatible  $S_S$  is probably capable of being used in a wide range of biomedical applications such as MRI, magnetic hyperthermia, and cancer treatment.