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Phytosynthesis of Iron Oxide Nanoparticles and their Application in the Degradation of Methylene Blue by the Fenton Process

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Abstract

Due to their adsorptive and catalytic properties, which result from the physicochemical characteristics of nanomaterials, nanoparticles stand out as effective solutions for removing dyes in effluents from the textile industry. It is known that iron oxide nanoparticles (FeNPs) act an efficient photocatalyst. [1]. These nanoparticles may be synthesized through different approaches, in special attention to the green route, using plant extract as a reducing agent and stabilizer during the synthesis, highlighting for its qualities of being environmentally friendly, having lower toxicity, offering good cost-benefit, consuming less energy and being easily scalable. [2-3]. The water hyacinth (*Eichhornia crassipes)* is a floating aquatic plant common in rivers and lakes in tropical and subtropical regions, specifically in the São Francisco River (Juazeiro-BA and Petrolina-PE border). It plays a crucial role in aquatic ecosystems, offering shelter and food to various species. Its rapid reproduction can result in uncontrolled growth, causing blockages in waterways and reducing environmental oxygenation. [2]. In the sense, the goal of this research is to synthesize FeNPs using aqueous (W) and ethanolic (E) *E. crassipes* extract as reducing and stabilizer agent. The synthesis was carrying out according to the literature. [1]. The aqueous (W) or ethanolic (E) extract (40 $g \cdot L^{-1}$) and $FeCl_3 \cdot 6H_2O$ (1 mM) were mixed in a 1:1 volume ratio for 60 min at 90 ºC and pH 10. The X ray diffraction (XRD) results suggest the presence of diffraction peaks that may be attributed to the hematite and ferrihydrite, and the broad, low intensity peaks may also indicate the presence of organic molecules from *E. crassipes.* [1,5]. The FeNPs were evaluated in a Fenton process with methylene blue (MB) and its degradation was monitored by UV-VIS spectroscopy (Figure 1 b-c). FeNPs degraded methylene blue (MB) in a Fenton process, with 80% degradation in 5 min and over 90% in 60 min. The study emphasizes the ecological benefits of using invasive plants for sustainable effluent remediation.

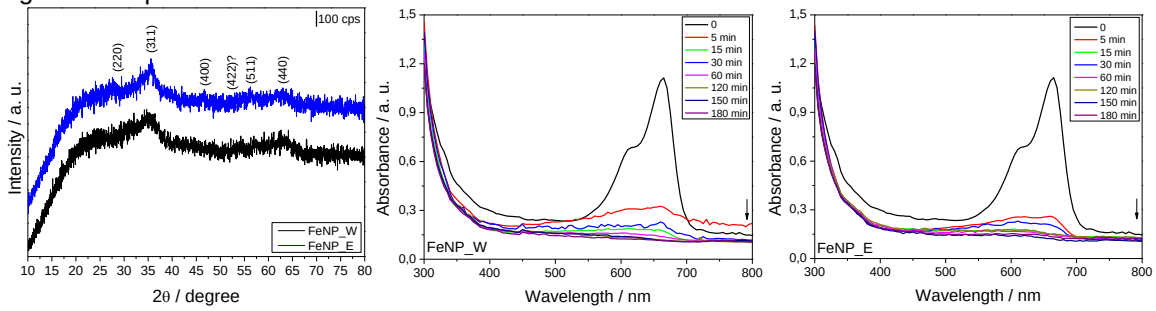

Figure 1. X ray diffraction (XRD) measurements of the FeNP_W and FeNP_E (a); Methylene blue degradation kinetics using FeNP_W (b) and FeNP_E (c). **Reaction Conditions**: m_{FeNPS}: 50 mg; H_2O_2: 5 mL (10% v/v); Dye solution: 45 mL (50 $mg \cdot L^{-1}$); Temperature: 25 °C.

Keywords: photocatalysis, plasmonic resonance, residual biomass.

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