ABSTRACT

The increase in organic waste from the cosmetics industry has encouraged the development of environmentally friendly photocatalyst materials that are effective for waste treatment processes. This study aims to synthesize Fe_3O_4/TiO_2 nanocomposites using a green synthesis method based on ketapang leaf extract (Terminalia catappa L.), to characterize their morphology and optical properties, and to analyze their effectiveness in the degradation of ataxanthin as a model of cosmetic industrial waste. Green synthesis was carried out by utilizing phytochemical compounds in ketapang leaf extract, such as flavonoids, phenolics, and tannins, which act as natural reducing and stabilizing agents in nanoparticle formation. Characterization was carried out using XRD, SEM-EDX, and UV-Vis spectroscopy, while photodegradation was performed on a 1.000 ppm astaxanthin solution under UV lamp irradiation for 180 minutes. XRD results confirmed the formation of Fe_3O_4 with a cubic inverse spinel structure and TiO_2 in the anatase phase with a tetragonal structure, with a crystallite size of 11,11 ± 0,22 nm. SEM-EDX reVealed the dispersion of TiO_2 on the surface of Fe_3O_4, with a composition of 79,79% Fe_3O_4 and 12,09% TiO_2. The bandgap energy of the Fe_3O_4/TiO_2 nanocomposite was 2,73 eV, lower than that of Fe_3O_4 (2,59 eV) and TiO_2 (2,94 eV), indicating a redshift resulting from heterojunction formation. Photodegradation tests showed that the Fe_3O_4/TiO_2 nanocomposite degraded astaxanthin by 54,19% ar 120 minutes, surpassing single Fe_3O_4 at 32,20% and single TiO_2 at 39,79%, with a degradation rate constant of 0,0019 min^{-1} and R^2 value of 0,2237. These results indicate that the Fe_3O_4/TiO_2 nanocomposite synthesuzed through a green synthesis approach holds considerable promise as an active photocatalyst in wastewater treatment, particularly for the degradation of organic compounds in the cosmetic industry.

***Keywords**: Fe_3O_4/TiO_2, green synthesis, photocatalyst, Terminalia catappa L., astaxanthin*