Silver Nanoparticles From Food Waste: An Innovative Green Synthesis to Remove Synthetic Dyes for Novel Applications in Water Treatment

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More than half the world's population, around 4.4 billion people, lack access to clean and safe drinking water. This is partially due to the contamination of synthetic organic dyes, which are chemical pollutants used in the textile industry, which is responsible for over 20% of global water pollution. Methylene blue, specifically, is a common synthetic organic dye that is toxic, carcinogenic, and non-biodegradable, posing a major risk to both human health and the environment. Silver nanoparticles (AgNPs) are a promising solution, acting as a catalyst for the degradation of organic dyes. However, current methods for synthesizing AgNPs are expensive and energy-intensive. The purpose of this study is to develop a green and cost-effective method using food waste to synthesize AgNPs that can catalyze the reduction of methylene blue using sodium borohydride ($NaBH_4$). Avocado, banana, and lemon peel extracts were each combined with a 10 mM silver nitrate ($AgNO_3$) solution to synthesize AgNPs, and UV-visible spectroscopy was used to determine the dye degradation kinetics over a 60-minute time period. All samples were run in triplicate. After performing two-tailed t-tests, it was found that the AgNPs made from avocado (69.8%), banana (93.4%), and lemon (89.6%) all could remove a statistically greater ($P < 0.05$) amount of methylene blue dye than the control, which only removed 18.4% of dye. These reactions are also extremely quick, for example, the banana AgNPs removed 80.7% of methylene blue dye in just five minutes. This is the first known study using avocado, banana, and lemon peels to synthesize AgNPs for enhanced dye degradation. Instead of food waste ending up in landfills and emitting greenhouse gases, it can be reused to sustainably degrade toxic dyes.

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