Comparative Study of Catalytic Reduction of Methylene Blue by Green Synthesized Copper Nanoparticles Using *Syzygium cumini* Leaves Extract

S.M.S.W. Sivirathne, S.A. Senevirathne and N.B. Jayaratna*

Department of Chemical Sciences, Faculty of Applied Sciences, Rajarata University of Sri Lanka
**Corresponding Author E-mail: naleen@as.rjt.ac.lk, TP: +94715376465*

Green synthesis using plant extracts is considered as an efficient, eco-friendly and inexpensive approach in metal nanoparticle synthesis. Copper nanoparticles are well known as catalysts in many organic reactions. The present study focuses on the green synthesis of heat and sunlight-induced copper nanoparticles using *Syzygium cumini* leaves aqueous extract as the source of reducing and capping agents. Synthesized nanoparticles were used to investigate and compare the catalytic effectiveness in the reduction reaction of Methylene Blue. The leaves extract was prepared by treating the leaves with distilled water at 50 °C for 1 hour. Copper nanoparticles were synthesized by mixing a known copper sulphate solution with leaves extract at a volume ratio of 5:3 followed by either heating (4 hours at 50 °C) or irradiating the mixture to sunlight for 4 hours. The synthesis of copper nanoparticles was initially recognized by the colour change of the extract solutions from pale yellow to dark brown. The formation of heat and sunlight derived copper nanoparticles were confirmed by UV-Visible peak maxima at 335 nm and 333 nm, respectively. Peak positions of Fourier transform infrared spectra of synthesized copper nanoparticles have revealed the activity of biomolecules as reducing and capping agents. Catalytic activities of synthesized copper nanoparticles were investigated using the reduction reaction of aqueous Methylene blue to Leucomethylene blue in the presence of excess $NaBH_4$ as a model reaction. The reaction progress was monitored by UV–Visible spectrophotometry at room temperature. The apparent rate constants of the reaction in the presence of heat and sunlight derived copper nanoparticle catalysts were 51.1×10^{-3} min^{-1} and 32.6×10^{-3} min^{-1} respectively. The apparent rate constant of the reaction in the absence of copper nanoparticle catalyst was 8.1×10^{-3} min^{-1}. The study confirms the catalytic activity of *Syzygium cumini* leaves derived copper nanoparticles while heat-induced copper nanoparticles showed 56% greater catalytic activity compared to sunlight-induced copper nanoparticles. Further characterization of nanoparticles and optimization of the biosynthesis parameters are needed to be performed.

***Keywords*:** Green synthesis; Dye degradation; Sunlight irradiation; Sustainability