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**GREEN SYNTHESIS, CHARACTERIZATION OF SILVER NANOPARTICLES USING  
WATERMELON SEED AND ITS ACTIVITY IN THE REMOVAL OF METHYLENE  
BLUE.**

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**GREEN SYNTHESIS, CHARACTERIZATION OF SILVER  
NANOPARTICLES USING WATERMELON SEED AND ITS ACTIVITY IN  
THE REMOVAL OF METHYLENE BLUE**

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This Final Year Project entitled “**Green Synthesis, Characterization of Silver Nanoparticles Using Watermelon Seed And Its Activity In The Removal Of Methylene Blue**” was submitted by Muhammad Arif Akmal Bin Mansor in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Chemistry with Management in the Faculty of Applied Sciences, and was approved by

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## ABSTRACT

### **GREEN SYNTHESIS, CHARACTERIZATION OF SILVER NANOPARTICLES USING WATERMELON SEED AND ITS ACTIVITY IN THE REMOVAL OF METHYLENE BLUE**

In this study, silver nanoparticles (AgNPs) were synthesized using watermelon seed extract via a green synthesis method, in which the extract acted as a natural reducing and stabilizing agent. AgNPs with silver loadings of 0.5%, 1.0%, 2.0%, and 5.0% were prepared and characterized using ICP-OES, FTIR, XRD, and FESEM. ICP-OES analysis confirmed the presence of silver in all samples, with Ag contents of 0.43%, 0.91%, 1.84%, and 4.78% for 0.5%, 1.0%, 2.0%, and 5.0% AgNPs, respectively, following the expected increasing trend with Ag loading. XRD analysis verified the formation of crystalline face-centered cubic (fcc) silver, with characteristic diffraction peaks at  $2\theta \approx 38^\circ$ ,  $44^\circ$ ,  $64^\circ$ , and  $77^\circ$ , corresponding to the (111), (200), (220), and (311) planes. FESEM analysis revealed nanoscale particles with average sizes of 16.4 nm (0.5% Ag), 20.5 nm (1.0% Ag), 30.5 nm (2.0% Ag), and 42.9 nm (5.0% Ag), with particle size increasing and aggregation becoming more pronounced at higher Ag loadings. The catalytic performance of the AgNPs was evaluated for the reduction of methylene blue (MB, 10 ppm) in the presence of  $\text{NaBH}_4$  (0.1 M) using UV–Vis spectroscopy, monitoring absorbance at 664 nm. MB removal increased rapidly in the first few minutes, reaching approximately 26.67–37.33% at 2 min and 40–56% at 3 min, with the highest removal of 93% at 5 min observed for 1.0% AgNPs at pH 9 and 3 mg catalyst. Lower Ag loadings (0.5%) achieved 72% removal at 5 min, while higher loadings (2.0% and 5.0%) showed reduced removal of 65% and 58%, respectively, due to larger particle size and aggregation that limit available active sites. Time studies further indicated that MB reduction was fastest with  $\text{NaBH}_4$ -assisted catalysis, while in the absence of  $\text{NaBH}_4$ , removal was slower and dominated by adsorption, requiring longer contact times to reach high efficiency. Overall, the results demonstrate that watermelon seed extract is an effective and sustainable precursor for AgNP synthesis, and that optimal Ag loading, particle size, and reaction conditions (pH, catalyst dosage, and contact time) are crucial for maximizing catalytic efficiency in wastewater treatment applications.

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