



SINTESIS DAN UJI AKTIVITAS NANOPARTIKEL TEMBAGA(II) OKSIDA (NP-CuO) SEBAGAI AGEN ANTIBAKTERI

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INTISARI

Sintesis nanopartikel tembaga(II) oksida (NP-CuO) untuk antibakteri telah dilakukan. Tujuan dari penelitian ini untuk mengetahui kondisi optimum sintesis nanopartikel tembaga(II) oksida meliputi pH, konsentrasi asam sitrat, temperatur, dan waktu reaksi. Penelitian ini juga bertujuan untuk mengetahui aktivitas antibakteri dari NP-CuO.

Penelitian ini diawali dengan sintesis nanopartikel tembaga(II) oksida (NP-CuO) menggunakan prekursor $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ dengan agen penudung asam sitrat. Parameter sintesis yang dioptimasi meliputi pH, konsentrasi asam sitrat, temperatur, dan waktu reaksi. Spektrofotometer UV-Vis digunakan untuk mengamati NP-CuO. NP-CuO pada kondisi optimal dikeringkan pada temperatur $95\text{ }^\circ\text{C}$ lalu dikalsinasi pada temperatur $600\text{ }^\circ\text{C}$ selama 4 jam. Serbuk NP-CuO dikarakterisasi menggunakan instrumen *Fourier transform Infrared Spectrophotometer* (FT-IR), *Scanning Electron Microscope with Energy Dispersive X-Ray spectrophotometer* (SEM-EDX), *X-Ray Diffraction* (XRD), dan *Transmission Electron Microscopy* (TEM). Aktivitas antibakteri dari NP-CuO dan matriks penyusunnya diuji dengan metode difusi cakram terhadap bakteri Gram positif *Staphylococcus aureus* dan Gram negatif *Escherichia coli*.

Hasil penelitian menunjukkan bahwa kondisi optimum sintesis NP-CuO dengan CuSO_4 10 mM terjadi pada saat kondisi pH 11 dengan konsentrasi asam sitrat 10 mM pada temperatur $60\text{ }^\circ\text{C}$ selama 60 menit. Keberhasilan sintesis NP-CuO dikonfirmasi oleh spektra FTIR dengan adanya puncak serapan Cu-O pada $556,7\text{ cm}^{-1}$ dan pada difraktogram XRD adanya puncak pada $2\theta = 35,30; 38,60; \text{ dan } 48,58^\circ$. Citra SEM menunjukkan bahwa permukaan NP-CuO berbentuk bulat tidak beraturan seperti batu karang. Data EDX menunjukkan persen massa Cu dan O pada NP-CuO masing-masing sebesar 69,30 dan 30,70%. Hasil analisis menggunakan TEM menunjukkan partikel berbentuk bulat dan silinder dengan distribusi ukuran rata-rata $43,23 \pm 10\text{ nm}$. Uji antibakteri menunjukkan bahwa NP-CuO memiliki aktivitas antibakteri yang tergolong sedang dimana zona hambat sebesar $8,10 \pm 0,0035\text{ mm}$ untuk *E. coli* dan $7,82 \pm 0,28\text{ mm}$ untuk *S. aureus*.

Kata kunci : antibakteri, asam sitrat, NP-CuO.



SYNTHESIS AND ACTIVITY TEST OF COPPER(II) OXIDE (CuO-NPs) NANOPARTICLES AS ANTIBACTERIAL AGENT

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ABSTRACT

Copper(II) oxide nanoparticles (CuO-NPs) have been synthesized for antibacterial agents. The goal of this study was to identify the ideal parameters, including pH, citric acid concentration, temperature, and time of reaction for the synthesis of copper(II) oxide nanoparticles. The effectiveness of CuO-NPs against bacteria also investigated.

This research was initiated by the synthesis of copper(II) oxide (CuO-NPs) nanoparticles using $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ as precursor with citric acid as a capping agent. UV-Vis analysis was used to determine the optimum conditions for the synthesis of NP-CuO by adjusting the pH, citric acid concentration, temperature, and time of reaction. NP-CuO sample prepared with the optimum condition was then dried at 95°C and then calcined at 600°C for 4 hours. CuO-NPs in a powder form were characterized using Fourier transform Infrared Spectrophotometer (FT-IR), Scanning Electron Microscope with Energy Dispersive X-Ray spectrophotometer (SEM-EDX), X-Ray Diffraction (XRD), and Transmission Electron Microscopy (TEM). The antibacterial activity of CuO-NPs and their matrix was tested by diffusion method against Gram-positive *Staphylococcus aureus* and Gram-negative *Escherichia coli* bacteria.

The result showed that the optimum conditions for the synthesis of CuO-NPs with CuSO_4 10 mM obtained at pH 11 with a citric acid concentration of 10 mM at 60°C for 60 min. CuO-NPs were successfully synthesized, confirmed by FTIR spectra with the absorption peak of Cu-O at 556.7 cm^{-1} and based on the XRD pattern at $2\theta = 35.30; 38.60; \text{ and } 48.58^\circ$. The surface morphology of CuO-NPs as a irregular round shape like a coral reef is confirmed by SEM analysis. EDX data shows the mass percentage of Cu and O in NP-CuO to be 69.30 and 30.70%, respectively. TEM images showed round and rod structure with an average size distribution of $43.23 \pm 10\text{ nm}$. Antibacterial test showed that CuO-NPs had fairly good antibacterial activity where the inhibition zone is $8.10 \pm 0.0035\text{ mm}$ for *E. coli* and $7.82 \pm 0.28\text{ mm}$ for *S. aureus*.

Keywords : antibacterial, citric acid, CuO-NPs.