

**PENAMBAHAN NANOPARTIKEL TEMBAGA OKSIDA PADA  
MINERAL TRIOKSIDA AGREGAT PUTIH UNTUK MENINGKATKAN  
KUAT TEKAN DAN SIFAT ANTIBAKTERI *STREPTOCOCCUS MUTANS*  
DAN *ESCHERICHIA COLI***

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**INTISARI**

Sintesis nanopartikel tembaga oksida (CuONP) untuk meningkatkan sifat mekanik dan antibakteri pada mineral trioksida agregat putih (WMTA) telah berhasil dilakukan. Tujuan penelitian ini adalah sintesis dan karakterisasi CuONP, serta mempelajari efek penambahan CuONP terhadap sifat fisik (kekristalan dan kuat tekan) dan sifat antibakteri WMTA terhadap bakteri *Streptococcus mutans* (*S. mutans*) dan *Escherichia coli* (*E. coli*).

Nanopartikel CuO disintesis dengan mencampurkan  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  0,5 M dan  $\text{Na}_2\text{CO}_3$  0,5 M pada variasi volume 15, 25 dan 42 mL melalui metode dekomposisi termal dan presipitasi. Material WMTA-CuO dibuat dengan mencampurkan WMTA dan CuONP pada variasi persentase massa (1, 2, dan 3 %). Nanopartikel CuO, material WMTA, dan WMTA-CuO dikarakterisasi dengan *Fourier Transform Infrared* (FTIR), *X-Ray Diffractometer* (XRD), dan *Scanning Electron Microscopy-Energy Dispersive Xray* (SEM-EDX). Analisis sifat mekanik WMTA dikaji dengan penambahan CuONP pada WMTA melalui pengujian kuat tekan dan pengujian sifat antibakteri terhadap bakteri *S. mutans* dan *E. coli* dengan waktu pendiaman pelet WMTA-CuO selama 14 hari.

Hasil karakterisasi FTIR dan XRD menunjukkan bahwa CuONP telah berhasil disintesis dan diperoleh ukuran rerata kristal sebesar 25,03 nm, ditandai adanya puncak-puncak karakteristik CuO dengan ukuran kristal pada masing-masing variasi, yaitu 28,41; 18,79; dan 27,90 nm. Penambahan CuONP pada WMTA mampu meningkatkan sifat mekaniknya, yaitu kuat tekan tertinggi  $10,86 \pm 0,78$  MPa ditunjukkan pada WMTA yang ditambah CuONP 1 % (WMTA-CuO(1)). Penambahan CuONP memberikan peningkatan terhadap antibakteri *S. mutans* dengan nilai zona hambat sebesar  $15,42 \pm 0,54$  mm untuk WMTA-CuO(3) dan terhadap *E. coli* dengan nilai zona hambat sebesar  $16,70 \pm 0,62$  mm pada WMTA-CuO(1).

Kata kunci: antibakteri, nanopartikel CuO, sifat mekanik, WMTA

**THE ADDITION OF COPPER OXIDE NANOPARTICLES ON WHITE  
MINERAL TRIOXIDE AGGREGATE TO IMPROVE THE COMPRESSIVE  
STRENGTH AND ANTIBACTERIAL PROPERTIES OF  
STREPTOCOCCUS MUTANS AND ESCHERICHIA COLI**

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**ABSTRACT**

The synthesis of copper oxide nanoparticles (CuONP) to improve the mechanical and antibacterial properties of white mineral trioxide aggregate (WMTA) has been successfully carried out. The objectives of this research were the synthesis and characterization of CuONP, as well as studying the effect of CuONP addition on the physical properties (crystallinity and compressive strength) and antibacterial properties of WMTA against *Streptococcus mutans* (*S. mutans*) and *Escherichia coli* (*E. coli*) bacteria.

CuO nanoparticles were synthesized by mixing  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  0.5 M and  $\text{Na}_2\text{CO}_3$  0.5 M at various volumes of 15, 25 and 42 mL through thermal decomposition and precipitation method. WMTA-CuO material was prepared by mixing WMTA and CuONP at various mass percentages (1, 2, and 3 %). CuO nanoparticles, WMTA, and WMTA-CuO materials were characterized by Fourier Transform Infrared (FTIR), X-Ray Diffractometer (XRD), and Scanning Electron Microscopy-Energy Dispersive Xray (SEM-EDX). The mechanical properties of WMTA were analyzed with the addition of CuONP to WMTA through compressive strength testing and antibacterial properties testing against *S. mutans* and *E. coli* bacteria with 14 days of WMTA-CuO pellet incubation time.

The results of FTIR and XRD characterization show that CuONP has been successfully synthesized and obtained an average crystal size of 25.03 nm, marked by the presence of characteristic peaks of CuO with crystal size in each variation, namely 28.41; 18.79; and 27.90 nm. The addition of CuONP to WMTA was able to improve its mechanical properties, namely the highest compressive strength of  $10.86 \pm 0.78$  MPa shown in WMTA added with 1% CuONP (WMTA-CuO(1)). The addition of CuONP improved the antibacterial effect against *S. mutans* with an inhibition zone value of  $15.42 \pm 0.54$  mm for WMTA-CuO(3) and against *E. coli* with an inhibition zone value of  $16.70 \pm 0.62$  mm for WMTA-CuO(1).

Keywords: antibacterial, CuO nanoparticles, mechanical properties, WMTA