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Antibacterial effect of silver and copper nanoparticles derived from *Klebsiella pneumoniae*-NSB2 strain against pathogenic bacteria

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The rising threat of multidrug-resistant (MDR) bacteria has escalated the search for alternative antimicrobial solutions, including the use of nanoparticles. This study evaluated antibacterial activity of biosynthesized silver (AgNP) and copper nanoparticles (CuNP), produced by the *Klebsiella pneumoniae* NSB-2 strain against *Escherichia coli* and *Staphylococcus aureus*. UV-Visible spectrophotometry confirmed the synthesis of these nanoparticles, with absorption peaks at 421 nm for AgNPs and 419 nm for CuNPs. TEM analysis revealed spherical nanoparticles with sizes of 29.3 nm for AgNPs and 31.5 nm for CuNPs. AgNPs demonstrated a minimum inhibitory concentration (MIC) of 30 µg/mL for both pathogens, while CuNPs had an MIC of 40 µg/mL for *E. coli* and 30 µg/mL for *S. aureus*. Both nanoparticles exhibited bactericidal activity at 40 µg/mL, with AgNPs showing greater antibacterial potency. Growth rate (µ) and doubling time (T_d) analyses revealed that bacterial growth slowed, and doubling times increased in the presence of both nanoparticles. Results indicate that AgNPs were more effective at lower concentrations compared to CuNPs, underscoring their stronger impact on bacterial growth kinetics. This study suggests that AgNPs and CuNPs hold promise as alternative treatments for MDR bacterial infections, with AgNPs showing superior efficacy.

Keywords: Nanomedicine, Specific growth rate, Doubling time, MDR, Bacterial growth kinetics