A Novel Synergistic Approach: Combining AMOX Antibiotic or Kigelia Extracts With AgZn NPs as a Potent and Efficient Strategy to Combat Antibiotic-resistant Bacteria

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Antibiotic drug resistance causes an estimated 1 million deaths each year and over 200 trillion USD in healthcare costs. Amoxicillin (AMOX) is an antibiotic effective against a broad range of Gram-negative and positive bacteria. However, Due to the extensive use, bacteria have developed resistance against them. This study aims to evaluate the antibacterial properties of ZnAg nanoparticles synthesized via an eco-friendly process using Kigelia leaf ethanolic extract. Additionally, it assesses the synergistic effects of combining these ZnAg nanoparticles with amoxicillin (AMOX@ZnAgNPs) to enhance their efficacy against multidrug-resistant bacteria. The major constituents of the Kigelia leaves extracts were screened by LCMS for being correlated with the antibacterial activity. The antibacterial activity of AMOX@ZnAg NPs was evaluated through zone of inhibition measurements and compared to other antibiotics, including vancomycin (0.59 mm), kanamycin (2.08 mm), tetracycline (3.15 mm), amoxicillin NPs (4.35 mm), and pure amoxicillin (1.67 mm). AMOX@ZnAg NPs showed a 260% increase in the inhibition zone against S. aureus compared to pure amoxicillin with an 80% reduction in dose. Furthermore, nanoparticles derived from Kigelia leaves exhibited strong antibacterial properties. Kigelia-ZnAgNPs showed a 72.73% increase in activity against E. coli, 40.36% against S. aureus, and 5.88% against S. enterica, compared to Kigelia leaf extract alone, with a 98% reduced dose. In conclusion, this novel synergistic study demonstrates enhanced antibacterial effectiveness, reduced resistance, and minimal adverse effects, offering promising applications in green synthesis, nanomedicine, and advanced antibacterial treatments.

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