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# Synthesis, Characterization, and Antibacterial Activity of ZnO Nanoparticles from Organic Extract of *Cola Nitida* and *Cola Acuminata* Leaf

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***Abstract***

*The study aimed at the synthesis and antibacterial activity of ZnO nanoparticles (NPs) from organic extracts of Cola nitida and Cola acuminata leaf using zinc chloride ($ZnCl_2$) and zinc acetate dihydrate [$Zn(CH_3COO)_2{\cdot}2H_2O$] as precursors on selected Gram positive and Gram negative microbes: Staphylococcus aureus, Exiguobacterium aquaticum, (Gram +ve) and Escherichia coli, Klebsielia pneumonia, Acinetobacter baumanni (Gram –ve). Spherical and flake-like nanostructures were recorded by Scanning Electron Microscopy (SEM) for C. acuminata and C. nitida respectively for the two precursors used. The average particle size and crystallite size determined by Transmission Electron Microscopy (TEM) and X-ray Diffraction (XRD) for C. acuminata and C. nitida were in the range of 32.15-43.26 nm; 69.12-84.26 nm and 14.69-17.12 nm; 23.68-23.96 nm respectively. Energy-dispersive X-ray spectroscopy (EDX), UV- visible spectroscopy (UV-vis), Atomic Absorption Spectroscopy (AAS) and Fourier-transform infrared spectroscopy (FT-IR) techniques were used to observe the purity and surface functional groups of the samples. Spectra peaks at 440-458 $cm^{-1}$ and 364-370 nm confirmed the presence of ZnO in the samples by FT-IR and UV-vis, whereas AAS at 213.9 nm wavelength further confirmed elemental zinc with a percentage atomic weight of 71.37% as against 69.50%, 18.8% and 11.1% for Zinc, Oxygen and Carbon by EDX. Data from the antibacterial activity studies show an increase in inhibition rate as concentration of the ZnO NPs increases in concentration from 25-1000 ppm. ZnO NPs from the two extracts recorded the highest inhibition rate in Acinetobacter baumanni of approximately 88% and 49% using $ZnCl_2$ and $Zn(CH_3COO)_2{\cdot}2H_2O$ respectively.*

***Keywords:*** *Precursor, Functional groups, Microscopy, Nanostructure, Spectroscopy*.

## 1. INRODUCTION

In recent years, microbial infection has become the cause of morbidity and mortality [1-3] and as a result, their causative agents (virus, bacteria, pathogenic fungi, protozoa) have developed resistant strains that withstand their clinical treatment using concomitant anti-drugs [4]. When the highly potent antibiotics are used, they generate various side effects, thus they are reserved only for critical infectious diseases. Currently, new methods for combating antibacterial drug resistance are being researched [5] resulting in the biosynthesis of nanoparticle with their diverse properties like chemical stability, catalytic activity,