

# Anticancer, Antibacterial and Hyperthermia Studies of Caffeine Based *N*-Heterocyclic Carbene Silver Complex Anchored on Magnetic Nanoparticles †

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**Abstract:** Caffeine-based *N*-heterocyclic carbene (NHC)-silver complex anchored on magnetic nanoparticles (MNP-Caff-NHC@Ag complex) has been prepared by covalent grafting of caffeine on the surface of chloro-functionalized Fe<sub>3</sub>O<sub>4</sub> magnetic nanoparticles followed by complexation with silver (I) acetate. The MNP-Caff-NHC@Ag complex has been characterized by various analytical techniques, including Fourier transform infrared (FT-IR) spectroscopy, energy-dispersive X-ray (EDX) spectroscopy, transmission electron microscopy (TEM), X-ray diffraction (XRD), thermogravimetric analysis (TGA), and vibrating sample magnetometer (VSM) analysis. The MNP-Caff-NHC@Ag complex displayed significant *in vitro* anticancer activity against the human hepatocarcinoma HepG2 cell line and antibacterial activity against *Escherichia coli* (NCIM-2832), *Staphylococcus aureus* (NCIM-2654), and *Bacillus cereus* (NCIM-2703). The hyperthermia studies revealed that the MNP-Caff-NHC@Ag complex achieved good therapeutic temperature (47°C) under the safe physiological range of field and frequency, thereby showing possible application as heating mediators in magnetic hyperthermia for selective killing of cancer cells.

**Keywords:** magnetic nanoparticles; caffeine; hepatocarcinoma; hyperthermia.

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## Conflicts of Interest

The authors declare no conflict of interest.