

Earthworm-mediated synthesis of silver nanoparticles: a potent tool against hepatocellular carcinoma, plasmodium falciparum parasites and malaria mosquitoes

ABSTRACT

The development of parasites and pathogens resistant to synthetic drugs highlighted the need for novel, eco-friendly and effective control approaches. Recently, metal nanoparticles have been proposed as highly effective tools towards cancer cells and Plasmodium parasites. In this study, we synthesized silver nanoparticles (EW-AgNP) using *Eudrilus eugeniae* earthworms as reducing and stabilizing agents. EW-AgNP showed plasmon resonance reduction in UV-vis spectrophotometry, the functional groups involved in the reduction were studied by FTIR spectroscopy, while particle size and shape were analyzed by FESEM. The effect of EW-AgNP on *in vitro* HepG2 cell proliferation was measured using MTT assays. Apoptosis assessed by flow cytometry showed diminished endurance of HepG2 cells and cytotoxicity in a dose-dependent manner. EW-AgNP were toxic to *Anopheles stephensi* larvae and pupae, LC(50) were 4.8 ppm (I), 5.8 ppm (II), 6.9 ppm (III), 8.5 ppm (IV), and 15.5 ppm (pupae). The antiplasmodial activity of EW-AgNP was evaluated against CQ-resistant (CQ-r) and CQ-sensitive (CQ-s) strains of *Plasmodium falciparum*. EW-AgNP IC(50) were 49.3 µg/ml (CQ-s) and 55.5 µg/ml (CQ-r), while chloroquine IC(50) were 81.5 µg/ml (CQ-s) and 86.5 µg/ml (CQ-r). EW-AgNP showed a valuable antibiotic potential against important pathogenic bacteria and fungi. Concerning non-target effects of EW-AgNP against mosquito natural enemies, the predation efficiency of the mosquitofish *Gambusia affinis* towards the II and III instar larvae of *A. stephensi* was 68.50% (II) and 47.00% (III), respectively. In EW-AgNP-contaminated environments, predation was boosted to 89.25% (II) and 70.75% (III), respectively. Overall, this research highlighted the EW-AgNP potential against hepatocellular carcinoma, Plasmodium parasites and mosquito vectors, with little detrimental effects on mosquito natural enemies.

Keyword: Arbovirus; Bacteria; Cancer; Chloroquine; *Eudrilus eugeniae*; Nanosynthesis