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 needing of 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 (EWï AgNP) using Eudrilus eugeniae earthworms as reducing and stabilizing agents. EWï AgNP showed plasmon resonance reduction in UVï vis spectrophotometry, the functional groups involved in the reduction were studied by FTIR spectroscopy, while particle size and shape was analyzed by FESEM. The effect of EWï 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. EWï AgNP were toxic to Anopheles stephensi larvae and pupae, LC50 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 EWï AgNP was evaluated against CQ-resistant (CQ-r) and CQ-sensitive (CQ-s) strains of Plasmodium falciparum. EWï AgNP IC50 were 49.3 ε g/ml (CQ-s) and 55.5 ε g/ml (CQ-r), while chloroquine IC50 were 81.5 ε g/ml (CQ-s) and 86.5 ε g/ml (CQ-r). EWï AgNP showed a valuable antibiotic potential against important pathogenic bacteria and fungi. Concerning non-target effects of EWï AgNP against mosquito natural enemies, the predation efficiency of the mosquitofish Gambusia affinis towards the II and II instar larvae of A. stephensi was 68.50% (II) and 47.00% (III), respectively. In EWï AgNP-contaminated environments, predation was boosted to 89.25% (II) and 70.75% (III), respectively. Overall, this research highlighted the EWï AgNP potential against hepatocellular carcinoma, Plasmodium parasites and mosquito vectors, with little detrimental effects on mosquito natural enemies.

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