Seaweed-synthesized silver nanoparticles: an eco-friendly tool in the fight against Plasmodium falciparum and its vector Anopheles stephensi?

ABSTRACT

Malaria, the most widespread mosquito-borne disease, affects 350-500 million people each year. Eco-friendly control tools against malaria vectors are urgently needed. This research proposed a novel method of plant-mediated synthesis of silver nanoparticles (AgNP) using a cheap seaweed extract of Ulva lactuca, acting as a reducing and capping agent. AgNP were characterized by UV-vis spectrophotometry, Fourier transform infrared (FTIR) spectroscopy, energy-dispersive X-ray spectroscopy (EDX), scanning electron microscopy (SEM), and X-ray diffraction (XRD). The U. lactuca extract and the green-synthesized AgNP were tested against larvae and pupae of the malaria vector Anopheles stephensi. In mosquitocidal assays, LC50 values of U. lactuca extract against A. stephensi larvae and pupae were 18.365 ppm (I instar), 23.948 ppm (II), 29.701 ppm (III), 37.517 ppm (IV), and 43.012 ppm (pupae). LC50 values of AgNP against A. stephensi were 2.111 ppm (I), 3.090 ppm (II), 4.629 ppm (III), 5.261 ppm (IV), and 6.860 ppm (pupae). Smoke toxicity experiments conducted against mosquito adults showed that U. lactuca coils evoked mortality rates comparable to the permethrin-based positive control (66, 51, and 41 %, respectively). Furthermore, the antiplasmodial activity of U. lactuca extract and U. lactuca-synthesized AgNP was evaluated against CQ-resistant (CQ-r) and CQ-sensitive (CQ-s) strains of Plasmodium falciparum. Fifty percent inhibitory concentration (IC50) values of U. lactuca were 57.26 µg/ml (CQ-s) and 66.36 µg/ml (CQ-r); U. lactuca-synthesized AgNP IC50 values were 76.33 µg/ml (CQ-s) and 79.13 µg/ml (CQ-r). Overall, our results highlighted out that U. lactuca-synthesized AgNP may be employed to develop newer and safer agents for malaria control.

Keyword: Culicidae; Malaria; Mosquito-borne diseases; Nanotechnologies; Smoke toxicity; Ulva lactuca