Towards bio-encapsulation of chitosan-silver nanocomplex? Impact on malaria mosquito vectors, human breast adenocarcinoma cells (MCF-7) and behavioral traits of non-target fishes

ABSTRACT

In this study, we synthesized and bio-encapsulated a chitosan-silver nanocomplex (Ch-AgNPs), characterizing it by UV–Vis spectroscopy, FTIR, EDX, SEM, XRD and Zeta potential analyses. The bio-encapsulated chitosan-Ag nanocomplex (BNC) was efficient as scavenger of free radicals (DPPH and ABTS), if compared to Ch-AgNPs. In toxicity assays against breast cancer cells (MCF-7) the BNC triggered apoptotic pathways, leading to a decline of MCF-7 cell viability with IC50 of 17.79 µg/mL after 48 h of exposure. LC50 of BNC on Anopheles stephensi ranged from 54.65 (larva I), to 98.172 ppm (pupa) while Ch-AgNPs LC50 ranged from 4.432 (I) to 7.641 ppm (pupa). In the field, the application of Ch-AgNP (10 × LC50) lead to A. stephensi larval reduction to 86.2, 48.4 and 100% after 24, 48, and 72 h, while the BNC nanocomplex exhibited 68.8, 36.4 and 100% larval reduction, respectively. Both Ch-AgNPs and the BNC reduced longevity and fecundity of A. stephensi. As regards to non-target effects on fish behavioral traits, in standard conditions, Poecilia reticulata predation on A. stephensi larvae was 70.25 (II) and 46.75 larvae per day (III), while post-treatment with sub-lethal doses of BNC, predation was boosted to 88.5 (II) and 70.25 (III) larvae per day.

Keyword: Biosafety; Biological control; MCF-7; Nanoparticle stability