Hydrothermal synthesis of titanium dioxide nanoparticles: mosquitocidal potential and anticancer activity on human breast cancer cells (MCF-7)

ABSTRACT

Mosquito vectors (Diptera: Culicidae) are responsible for transmission of serious diseases worldwide. Mosquito control is being enhanced in many areas, but there are significant challenges, including increasing resistance to insecticides and lack of alternative, cost-effective, and eco-friendly products. To deal with these crucial issues, recent emphasis has been placed on plant materials with mosquitocidal properties. Furthermore, cancers figure among the leading causes of morbidity and mortality worldwide, with approximately 14 million new cases and 8.2 million cancer-related deaths in 2012. It is expected that annual cancer cases will rise from 14 million in 2012 to 22 million within the next two decades. Nanotechnology is a promising field of research and is expected to give major innovation impulses in a variety of industrial sectors. In this study, we synthesized titanium dioxide (TiO2) nanoparticles using the hydrothermal method. Nanoparticles were subjected to different analysis including UVï Vis spectrophotometry, Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), zeta potential, and energy-dispersive spectrometric (EDX). The synthesized TiO2 nanoparticles exhibited dose-dependent cytotoxicity against human breast cancer cells (MCF-7) and normal breast epithelial cells (HBL-100). After 24-h incubation, the inhibitory concentrations (IC50) were found to be 60 and 80 ε g/mL on MCF-7 and normal HBL-100 cells, respectively. Induction of apoptosis was evidenced by Acridine Orange (AO)/ethidium bromide (EtBr) and 4N6-diamidino-2-phenylindole dihydrochloride (DAPI) staining. In larvicidal and pupicidal experiments conducted against the primary dengue mosquito Aedes aegypti, LC50 values of nanoparticles were 4.02 ppm (larva I), 4.962 ppm (larva II), 5.671 ppm (larva III), 6.485 ppm (larva IV), and 7.527 ppm (pupa). Overall, our results suggested that TiO2 nanoparticles may be considered as a safe tool to build newer and safer mosquitocides and chemotherapeutic agents with little systemic toxicity.

Keyword: Antibacterial activity; Apoptosis; Chemotherapy; Cytotoxicity; DAPI; MCF-7 cells; TiO2; Western blot