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Title: An in vitro comparative evaluation of anthelmintic activity of compounds based on pure and doped carbon quantum dots against egg and larval stages of Strongylidea

Abstract

Strongyle nematodes pose a major challenge in veterinary parasitology, causing significant economic losses in livestock due to resistance to conventional treatments. Current anthelmintics, like Ivermectin, often encounter resistance issues. This study aims to address these gaps by synthesizing Carbon Quantum Dots (CQDs) and Copper-Doped CQDs (Cu@CQDs) using glucose extract, and evaluating their nematicidal properties against strongyles in vitro. We assessed the nematicidal effects of CQDs and Cu@CQDs through larval feeding inhibition of first-stage larvae (L1), egg hatch inhibition (EHI), and the mobility and mortality of infectious larvae (L3s). Additionally, we conducted ultrastructural examinations of eggs and larvae and evaluated oxidative/nitrosative stress indicators, including total antioxidant status (TAS), protein carbonylation (PCO), lipid peroxidation (MDA), and oxidative DNA damage in homogenized samples of L3s. The synthesized CQDs displayed semi-spherical morphology with diameters under 30 nm. Cu@CQDs at 12.5 µg/ml achieved over 90% EHI and larval motility inhibition. Fluorescence microscopy confirmed over 90% larval feeding inhibition at the same concentration. Both CQDs and Cu@CQDs induced oxidative stress, indicated by decreased TAS and increased MDA, PCO, and oxidative DNA damage. Scanning Electron Microscopy showed that CQDs and Cu@CQDs penetrated the larvae cuticle, altered the tegument, caused larval mortality, and resulted in egg deformities. Given the potential for resistance to Ivermectin, seeking suitable alternatives is essential. Cu@CQDs exhibit effects similar to Ivermectin, indicating their potential as novel antiparasitic agents against strongyles. These findings emphasize the importance of exploring alternative treatments to address resistance and enhance nematode control efficacy.

Keywords: Carbon quantum dots, Strongyle, Antiparasite, Oxidative stress, DNA damage