Ecofriendly Curcumin-Conjugated Copper Oxide Nanoparticles: Targeted Cytotoxicity and Apoptosis in Oral Carcinoma KB Cells

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Aims and scope

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Abstract

Curcumin and copper oxide nanoparticles (CuONPs) have captured the attention of researchers due to their promising applications in pharmacology, biotechnology, and medicine in recent times. This study reports the green synthesis of copper oxide nanoparticles using *Coriandrum sativum* extract and their subsequent conjugation with

curcumin. The formation of nanoparticles is indicated by a color change in the solution, and the subsequent darkening upon adding curcumin confirms the successful conjugation of curcumin with CuONPs (Cur-CuONPs). The stability, spherical shape, and size range of 13–14 nm of the nanoparticles is confirmed by characterization methods as UV-visible spectrophotometry, FTIR, Zeta potential, SEM, EDX, and TEM studies. The MTT experiment revealed that the synthesized Cur-CuONPs were significantly cytotoxic against KB cells, with an IC_{50} value of 16.33 µg/mL, but less cytotoxic against healthy cells (IC_{50} of 68.26 µg/mL). FITC Annexin V flow cytometry was used to confirm apoptosis, and EtBr/AO staining revealed morphological alterations and cell blebbing. Reactive oxygen species production (91.99% DCF intensity expression) and significant mitochondrial damage—confirmed by JC1 staining—were credited with causing the apoptosis. Furthermore, in KB cells, Cur-CuONPs caused cell cycle arrest at the Sub G0/G1, S, and G2/M phases. DAPI analysis verified the DNA damage, which was shown by condensation and blebbing of the DNA. RT-PCR testing supported the findings that the anti-apoptotic Bcl2 gene was downregulated and that other apoptotic genes, such as p53, caspase-3, and caspase-8, caspase9 and Bax were upregulated. These results suggest that Cur-CuONPs have promising potential for targeted drug delivery applications due to their selective cytotoxicity against KB cells."