Zinc oxide nanoparticles: Synthesis, antiseptic activity and toxicity mechanism

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Zinc oxide nanoparticles: synthesis, antiseptic activity and toxicity mechanism

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Abstract

Zinc oxide (ZnO), as a material with attractive properties, has attracted great interest worldwide, particularly owing to the implementation of the synthesis of nano-sized particles. High luminescent efficiency, a wide band gap (3.36 eV), and a large exciton binding energy (60 meV) has triggered intense research on the production of nanoparticles using different synthesis methods and on their future applications. ZnO nanomaterials can be used in industry as nano-optical and nano-electrical devices, in food packaging and in medicine as antimicrobial and antitumor agents. The increasing focus on nano zinc oxide resulted in the invention and development of methods of nanoparticles synthesis. Recently, various approaches including physical, chemical and biological (*"green chemistry"*) have been used to prepare ZnO nanocomposites with different morphologies. The obtained nanoparticles can be characterized with a broad range of analytical methods including dynamic light scattering (DLS), electron microscopy (TEM, SEM), UV-VIS spectroscopy, X-ray diffraction (XRD) or inductively coupled plasma with mass spectrometry (ICP-MS). With these it is possible to obtain information concerning the size, shape and optical properties of nanoparticles. ZnO NPs exhibit attractive antimicrobial properties against bacteria (Gram-positive and Gram-negative) and fungi. Zinc oxide nanocomposites show also selective toxicity toward normal and cancerous cells, which is explained by reactive oxygen formation (ROS). Yet despite the potentially interesting antitumor activity of ZnO nanoparticles, it has been proven that they can be also cytotoxic and genotoxic for multiple types of human cells (i.e. neuronal or