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Recent advances in the synthesis and characterization of nano-antimicrobials

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Highlights

- Infections caused by antimicrobial resistant bacteria are a major cause of mortality;
- Nano-antimicrobials are a valuable alternative to molecular antibiotics;
- There is a great need of high purity and monodisperse bioactive nanoparticles;
- Nanoparticles might cause adverse toxic effects: nano-safety is still an issue.

Abstract

The application of metals and metal oxides in the form of nanostructured antimicrobials is continuously expanding. In the last decades, especially Cu-, ZnO- and Ag-based nano-antimicrobials have attracted the interest of scientists and technologists, as assessed by the huge amount of reports on the synthesis and characterization of nanosized bioactive materials. In fact, despite numerous and strong antibiotics nowadays available, infections caused by antimicrobial resistant bacteria are still a major cause of morbidity and mortality. Consequently, attention has been devoted to the development of nanoparticle-based antimicrobial agents: several classes of antimicrobial nanoparticles (NPs) and nanosized carriers for antibiotics delivery have proven their effectiveness for treating infectious diseases, including antibiotic resistant ones, in vitro as well as in animal models. The present review discusses the recent advances in synthesis, characterization, and application of Cu-, ZnO-, and Ag-based nano-antimicrobials, along with a brief mention of nanotoxicology issues.

Keywords

Nano-antimicrobials; Nano-antimicrobial composites; Antimicrobial resistance; Nanoparticle synthesis; Nanotoxicology

Abbreviations

AAS = Atomic absorption spectroscopy; AFM = Atomic force microscopy; ATR-FTIR = Attenuated total reflectance – Fourier transform infrared spectroscopy; BBB = Blood brain barrier; BSE = Backscattered electrons; CNS = Central nervous system; ESI = Electrospray Ionization; FE-SEM = Field emission scanning electron microscopy; MALDI = Matrix-assisted laser desorption ionization; MD = Molecular dynamics; MS = Mass Spectrometry; NPs = Nanoparticles; PCT = Patch clamp technique; PTFE = Polytetrafluoroethylene; PVMK = Poly (vinyl methyl ketone); QSAR = Quantitative structure-activity

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