Microbial synthesis of zinc oxide nanoparticles and their potential application as an antimicrobial agent and a feed supplement in animal industry: a review

ABSTRACT

In recent years, zinc oxide nanoparticles (ZnO NPs) have gained tremendous attention attributed to their unique properties. Notably, evidence has shown that zinc is an important nutrient in living organisms. As such, both prokaryotes and eukaryotes including bacteria, fungi and yeast are exploited for the synthesis of ZnO NPs by using microbial cells or enzyme, protein and other biomolecules compounds in either an intracellular or extracellular route. ZnO NPs exhibit antimicrobial properties, however, the properties of nanoparticles (NPs) are depended upon on their size and shape, which make them specific for various applications. Nevertheless, the desired size and shape of NPs can be obtained through the optimization process of microbes mediated synthesis by manipulating their reaction conditions. It should be noted that ZnO NPs are synthesized by various chemical and physical methods. Nonetheless, these methods are expensive and not environmentally friendly. On that account, the microbes mediated synthesis of ZnO NPs have rapidly evolved recently where the microbes are cleaner, eco-friendly, non-toxic and biocompatible as the alternatives to chemical and physical practices. Moreover, zinc in the form of NPs is more effective than their bulk counterparts and thus, they have been explored for many potential applications including in animals industry. Notably, with the advent of multi-drug resistant strains, ZnO NPs have emerged as the potential antimicrobial agents. This is mainly due to their superior properties in combating a broad spectrum of pathogens. Moreover, zinc is known as an essential trace element for most of the biological function in the animal's body. As such, the applications of ZnO NPs have been reported to significantly enhance the health and production of the farm animals. Thus, this paper reviews the biological synthesis of ZnO NPs by the microbes, the mechanisms of the biological synthesis, parameters for the optimization process and their potential application as an antimicrobial agent and feed supplement in the animal industry as well as their toxicological hazards on animals.

Keyword: Animals; Antimicrobial; Feed supplement; Microbial synthesis; Nanotechnology; Zinc oxide nanoparticles