Antimicrobial Activity of Silver Nanoparticles Prepared Under an Ultrasonic Field

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ABSTRACT

Nanotechnology has great promise for improving the therapeutic potential of medicinal molecules and related agents. In this study, silver nanoparticles of different sizes were synthesized in an ultrasonic field using the chemical reduction method with sodium borohydride as a reducing agent. The size effect of silver nanoparticles on antimicrobial activity were tested against the microorganisms Staphylococcus aureus (MTCC No. 96), Bacillus subtilis (MTCC No. 441), Streptococcus mutans (MTCC No. 497), Escherichia coli (MTCC No. 739) and Pseudomonas aeruginosa (MTCC No. 1934). The results shows that B. subtilis, and E. coli were more sensitive to silver nanoparticles and its size, indicating the superior antimicrobial efficacy of silver nanoparticles.

KEYWORDS: Optical absorption; silver NP; particle size analyzer; antimicrobial activity; size effect.

Introduction

Silver and silver ions have long been known to have strong inhibitory and antibacterial effects (Kim et al., 1998). The resurgence of the use of silver-based antiseptic materials may be linked to a broad spectrum of activity and a lower propensity to induce microbial resistance than antibiotics (Jones et al., 2004).

Many researchers have tried to measure the activity of metal ions against microorganisms. Even though copper and zinc show antimicrobial properties, these nanoparticles have limited usefulness as an antimicrobial agent for several reasons, including the interfering effects of salts and the antimicrobial mechanism. These limitations can be overcome with silver nanoparticles, which exhibit efficient antimicrobial property compared to other salts due to their large surface area providing better contact with microorganisms. The nanosize space allowed expansion of the contact surface of silver with the microorganisms and this nanoscale has applicability for medical devices as surface-coating agents (Kim et al., 2004).

The nano-silver can inhibit the growth of a wide variety of microorganisms. Recently, health care providers and researchers took a renewed interest in silver because the pathogens, when exposed, showed increased resistance capability to antibiotics. In addition, the nanoscale technique development for producing silver nanoparticles may assist medical use, especially in applications where fighting germs is a major concern.

Silver nanoparticles which have a high specific surface area and a high fraction of surface atoms have attracted the attention of the industry because of their unique characteristics of high efficiency and antimicrobial activity even at low concentration volumes (Kowshik et al., 2003; Duran et al., 2005). Silver nanoparticles also possess low toxicity to human cells, high thermal stability and low volatility (Duran et al., 2007). Silver nanoparticles can be therefore be exploited in medicine for burn treatment, dental materials, coating stainless steel materials, textile fabrics, water treatment and sunscreen lotions.

In the present study, silver nanoparticles of different sizes were prepared in an ultrasonic field. Antimicrobial activity of silver nanoparticles and its size effect have been tested against five different microorganisms Staphylococcus aureus (MTCC No. 96), Bacillus subtilis (MTCC No. 441), Streptococcus mutans (MTCC No. 497), Escherichia coli (MTCC No. 739) and Pseudomonas aeruginosa (MTCC No. 1934).

Materials and Methods

Materials

Silver nitrate and sodium borohydride were obtained from Aldrich Chemicals, India. They were used as such without any further purification.