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Evaluating Antimicrobial Activity of Selenium Nanoparticles Against Food-Borne Bacteria

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Abstract : Selenium is an essential micronutrient for all mammals and plays an important role in maintaining human physiological functions. The potential applications of selenium as food supplements, cancer-prevention, antimicrobial and anti-inflammatory agents have been investigated in biomedicine and food sciences. Nanoscale of selenium is of particular interest due to its better biocompatibility, higher bioavailability, lower toxicity, more homogeneous distribution, and presumptive controlled release of substances. The objective of this study is to explore whether selenium nanoparticle (SeNP) has the potential to be used as a food preservative to reduce food spoilage. SeNPs were synthesized through ascorbic acid reduction of sodium selenite using the bovine serum albumin (BSA) as capping and stabilizing agent. The chemically synthesized SeNPs had a spherical conformation and a size of 22.8 ± 4.7 nm. FTIR analysis confirmed that the nanoparticles were covered with BSA. We further tested the antimicrobial activity of these SeNPs against common food-borne bacteria. Colony forming unit assay showed that SeNPs exhibited good inhibition on the growth of Listeria Monocytogens (ATCC15313), Staphylococcus epidermidis (ATCC 700583) starting at 0.5µg/mL, but only a moderate inhibitory effect on the growth of Staphylococcus aureus (ATCC12600) and Vibrio alginolyticus (ATCC 33787) at a concentration higher than 10µg/mL and 2.5µg/mL, respectively. There was a mild effect against the growth Salmonella enterica (ATCC19585) when the concentration reached 15µg/mL. No inhibition was observed in the growth of Enterococcus faecalis (ATCC 19433). Surprisingly, SeNPs appeared to promote the growth of Vibrio parahaemolyticus (ATCC43996) and Salmonella enterica (ATCC49284) at 30 µg/mL and above. Our preliminary data suggested that the chemically synthesized SeNPs may be able to inhibit some food-borne bacteria, and SeNP as a food preservative should be used with caution. We will explore the mechanisms of the inhibitory action of chemically synthesized SeNPs on bacterial growth and whether the SeNPs are able to inhibit the development of biofilm and antibiotic resistance.

Keywords : antimicrobial, food-borne bacteria, nanoparticles, selenium
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