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Abstract

Synthesis and Characterization of Medium Molecular Weight Chitosan-Stabilized Selenium Nanoparticles †

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Due to its involvement in physiological, metabolic and pharmacological actions, selenium is considered an essential micronutrient in human nutrition. Red selenium nanoparticles (Se NPs) have been shown to have excellent bioavailability, antioxidant activity and low toxicity making them an alternative to inorganic and organic forms of selenium [1]. In agriculture Se NPs gained attention as antimicrobial agents, growth promoters, crop biofortification, and nutraceuticals [2]. Chitosan (CS) is the only positively charged natural polysaccharide and is extracted from the exoskeleton of arthropods, insects and fungi. Massivley studied and used as a carrier for various drugs because of its low toxicity, CS was tested for SeNPs encapsulation and stabilizer [3]. The main aim of this study was to obtain and characterize SeNPs capped by chitosan with medium molecular weight (CS-SeNPs). SeNPs were obtained by chemical reduction of sodium selenite with ascorbic acid added dropwise. Chitosan was used as stabilizer agent for Se NPs. A solution of 1% medium molecular weight chitosan (in 4% acetic acid) was added dropwise to the system and stirred for 30 min at 1000 rpm to prevent the aggregation of the synthesized particles. CS-Se NPs were characterized with SEM, TEM-EDX, DLS, and XRD. The antioxidant activity of the nanoparticles was determined by DPPH method. The formation of SeNPs was confirmed by the color of the mixture turning deep red. The HR-TEM and SEM images reveal the homogeneity of the sample and the distribution of the uniform spherical Se NPs. The average particle size of CS-SeNPs was 100 and 270 nm, as determined by TEM, UV-VIS and DLS, respectively. The XRD analysis showed the amorphous CS-SeNPs formation. EDX confirmed Se as the major element in CS-SeNPs. The antioxidant activity of CS-SeNPs was found to be 13.35 µM equivalent Trolox/ml. Our study obtained medium molecular weight chitosan-stabilized selenium nanoparticles with high antioxidant activity and high stability, which could be used for agricultural applications.

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