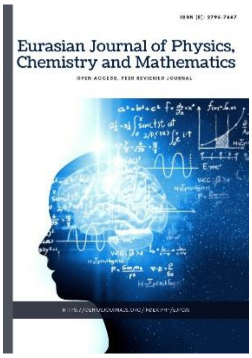

Synthesis Of Selenium Nanoparticles

Farah S. Daabool	[1] College of biotechnology, Al-Qasim Green University, Hilla, Iraq Email: farah_s_daabool@uoqasim.edu.iq
Emad Khalifa,	College of biotechnology, Al-Qasim Green University, Hilla, Iraq
Ali Hadi	College of biotechnology, Al-Qasim Green University, Hilla, Iraq
Ali Qassem	College of biotechnology, Al-Qasim Green University, Hilla, Iraq

ABSTRACT

Selenium is a trace micronutrient that is necessary for human, animal, and microbial health. Many academics have recently become interested in selenium nanoparticles (SeNPs) due to its biocompatibility, bioavailability, and low toxicity. keywords: selenium , nanoparticles ,XRD,SEM. As a result of their increased bioactivity, selenium nanoparticles are widely used in a variety of biological applications. Physical, chemical, and biological approaches can all be used to make selenium nanoparticles. The organically generated SeNPs, on the other hand, are more compatible with human organs and tissues.

Many studies have looked at the impact of size, shape, and the technology used to synthesize them on their applicability in biological systems.

This article examines the numerous synthesis processes used to make them, as well as their biological applications, including as the treatment of fungal, bacterial, and parasite infections, cancer, and diabetes.

They can also be used as chemopreventive, anti-inflammatory, and antioxidant agents.el.

Keywords: Nanoparticles, selenium , XRD .

Introduction:

Nanotechnology is a growing branch of current science that focuses on the design, manufacture, and operation of particle formations by sizes reaching from 1 to 100 nm.

Wide application used nano science such as medical services, skincare, food industry, environmental safety, machine design, photonic, biomedical sciences, chemical plants, electronics, space industries, drug / gene, power science, optoelectronic devices, analytical chemistry, charge transfer transistors, light emitters, non - linear optical devices, and photo-electrochemical devices, optoelectronics, photocatalyst, single electron transistors, light emitters, nonlinear optical devices, and series of pictures.

There exists a rising demand to design environmentally friendly synthesis techniques that do not employ harmful compounds. Green synthesis methods include made by mixing polyoxometalates, carbohydrates, Tollens, microbiological, and irradiation procedures, which have advantages over standard processes that involve environmentally harmful chemical agents[1-10].

The selection of a solvent medium and enviromentally nontoxic decreasing and stabilizing agents are the most essential variables in green Nanoparticle synthesis[11-15] .

Nanoscience and technology have exploded in popularity in recent years, owing to both the advent of new ways for synthesizing nanomaterials and the availability of tools for classification and manipulation of nanoparticles. Understanding the principles of nanoscale chemistry and physics, as well as the know-how to commercialize nanoparticles, is required for their production. Nanoparticle manufacturing can be divided into two categories: top-down and bottom-up. The former reduces the size of a substance from large to nanoscale, whereas the latter creates nanomaterials from the atomic level up.

Many metal are important for healthy of humans one of these is selenium . it can synthesis by several methods physical ,chemical and biological. Selenium is found as two types organic and inorganic form a crystalline and amorphous in nature[16-19].

Chemical reduction of inorganic selenium forms as precursors is the most widely utilized approach for producing SeNPs.

However, residuals of these compounds limit the pharmacological and medical applications of the produced SeNPs.

Material and Methods

Materials

sodium tetrahydridoborate ($NaBH_4$) 98%, and sodium selenite (Na_2SeO_3 98%) were purchased from Sigma-Aldrich. Without a purification process, these known concentration compounds were used..

a- Production of Se nanoparticles

SeNPs were synthesis from a reduction.of sodium selenite by Sodium borohydride . Briefly, 1.7 g of Na_2SeO_3 was added to 50 mL of $NaBH_4$(0.1M) was additional dropwise to sodium selenite.solution with stirring at 200 C°. Selenium nanoparticles were formed after the addition of $NaBH_4$.

A change in color in the reactant mixture from pure white to pure orange may be seen. All of the solutions were produced in a sterile environment with double distilled water and a sterile closet. After that, the fluid was centrifuged at 12000 rpm to capture the selenium nanomaterials[20-25] .

Results & Discuss

Characterization of the Synthesis Se

In this study, Sodium borohydride was used to synthesize monodisperse SeNPs with biocompatibility and good reducing characteristics using a simple wet chemical technique. In aqueous media, the selenium oxyanion SeO32) was produced. Selenium was converted to elemental selenium when this solution reacted with Sodium borohydride give (Se0.(

Figure 1 shows the Se nanoparticles' distinctive absorption peak. The presence of a strong peak at 265 nm, as well as the colloidal dispersion's bright orange color, demonstrates the production of Se nanoparticles. The spherical form of the nanoparticles was revealed by scanning electron microscopy analysis of the purified samples (Fig. 1b). The nanoparticles were 35.6 7.5 nm in size, according to SEM analysis using Image J software.

1-XRD analysis

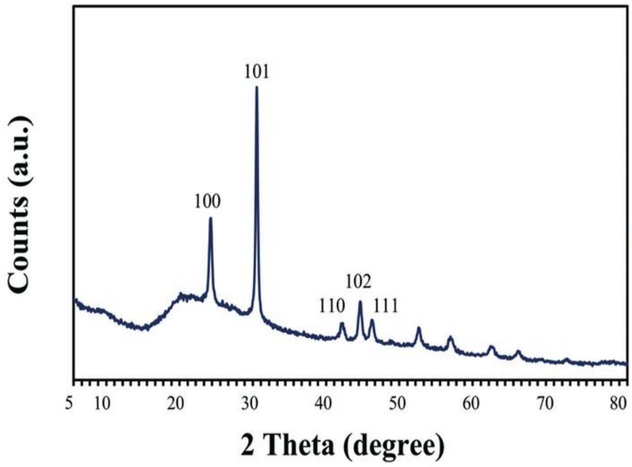

Figure 1 : XRD of selenium

The crystal structure and composition of the synthesized nanoparticles were characterized by XRD in range of 10-90o and produced as Fig. 5. The sharp and narrow peaks were noticed and impurities peaks were not observed , suggesting the formation of high purity and well crystallized SeNPs. The selenium peaks centred at 2θ of 23.5o, 29.7o, 41.4o, 43.6o, 45.4o, 51.7o, 55.9o, and 61.5o corresponded to the crystal planes of (100), (101), (110), (102), (111), (201), (112) and (202) of JCPDS card No. 06-362) standard. The SeNPs having hexagonal structure were successfully formed, and the lattice constants were a = 4.36 Å and c = 4.95 Å as per (JCPDS card No. 06-362(standard. The peak intensities of (100) and (101) planes were enhanced and suggested that the SeNPs has been favoring to grow along the (202) direction [26-30].

2- The SEM analysis

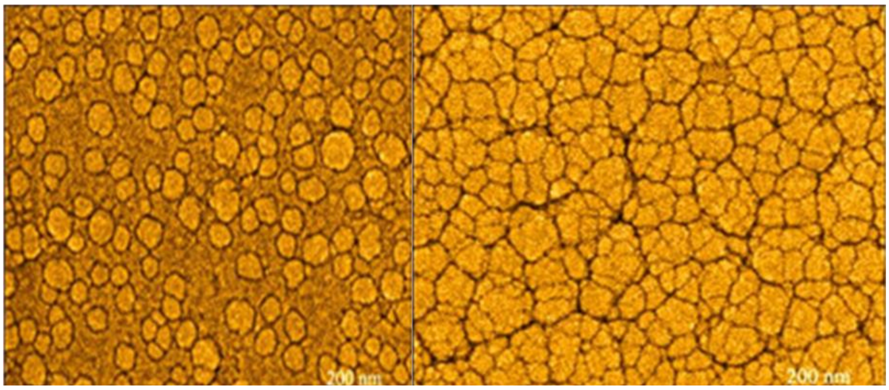

Figure 2: SEM of selenium

Figure (2) display the Scanning Electron Microscope (SEM) photograph for nano selenium, where sodium selenite has been used in its preparation as the starting material at a temperature of 300 oC. The morphological investigation of the prepared Se powder took place by means of scanning electron microscopy (SEM). As presented in Fig. 2, the estimation for the average size of Se particles would be about 50- 80 nm. The SEM image illustrates the homogeneity and agglomeration of the powder.

4 .Conclusion

In this study, SeNPs were synthesized using vitamin C as reducing and stabilizing agent by hydrothermal technique. The vitamin C was determined to play an effective role as reducing agent in controlling the size of particles. The technique employed here is very simple, inexpensive and eco-friendly. Different characterization techniques such as Uv-vis,, XRD and SEM support the structure, size and crystallinity of selenium nanoarticles, indicating that SeNPs could be a promising candidate for wide range of applications.

References

1. Vimbela, G. V., Ngo, S. M., Fraze, C., Yang, L. & Stout, D. A. Antibacterial properties and toxicity from metallic nanomaterials. *International Journal of Nanomedicine*, https://doi.org/10.2147/IJN.S134526 (2017).
2. Alpaslan, E., Geilich, B. M., Yazici, H. & Webster, T. J. pH-controlled cerium oxide nanoparticle inhibition of both gram-positive and gram-negative bacteria growth. *Sci. Rep.***7**, 45859 (2017).
ADS CAS Article Google Scholar
3. Beyth, N., Houri-Haddad, Y., Domb, A., Khan, W. & Hazan, R. Alternative antimicrobial approach: Nano-antimicrobial materials. *Evidence-based Complementary and Alternative Medicine*, https://doi.org/10.1155/2015/246012 (2015).
4. Skalickova, S. *et al*. Selenium nanoparticles as a nutritional supplement. *Nutrition***33** (2017).
5. Tran, P. A. *et al*. Low cytotoxic trace element selenium nanoparticles and their differential antimicrobial properties against *S. aureus* and *E. coli*. *Nanotechnology***27** (2015).
6. Hosnedlova, B. *et al*. IJN-157541-nano-selenium-and-its-nanomedicine-applications–a-critical. *Int. J. Nanomedicine Dovepress***13**, 2107–2128 (2018).
CAS Article Google Scholar

7. Yu, B., Zhang, Y., Zheng, W., Fan, C. & Chen, T. Positive surface charge enhances selective cellular uptake and anticancer efficacy of selenium nanoparticles. *Inorg. Chem.***51**, 8956–8963 (2012).
CAS Article Google Scholar
8. Forootanfar, H. *et al*. Antioxidant and cytotoxic effect of biologically synthesized selenium nanoparticles in comparison to selenium dioxide. *J. Trace Elem. Med. Biol.***28**, 75–79 (2014).
CAS Article Google Scholar
9. Shakibaie, M., Forootanfar, H., Golkari, Y., Mohammadi-Khorsand, T. & Shakibaie, M. R. Anti-biofilm activity of biogenic selenium nanoparticles and selenium dioxide against clinical isolates of Staphylococcus aureus, Pseudomonas aeruginosa, and Proteus mirabilis. *J. Trace Elem. Med. Biol.***29**, 235–241 (2015).
CAS Article Google Scholar
10. Hariharan, H., Al-Dhabi, N. A., Karuppiah, P. & Rajaram, S. K. Microbial synthesis of selenium nanocomposite using Saccharomyces cerevisiae and its antimicrobial activity against pathogens causing nosocomial infection. *Chalcogenide Lett***9**, 509–515 (2012).
CAS Google Scholar
11. Shahverdi, A. R. *et al*. Antifungal activity of biogenic selenium nanoparticles. *World Appl. Sci. J.***10**, 918–922 (2010).
CAS Google Scholar
12. Beheshti, N. *et al*. Efficacy of biogenic selenium nanoparticles against Leishmania major: *in vitro* and *in vivo* studies. *J. Trace Elem. Med. Biol.***27**, 203–207 (2013).
CAS Article Google Scholar
13. Behbahani, M., Nosrati, M. & Mohabatkar, H. Inhibition of human immunodeficiency type 1 virus (HIV-1) life cycle by different egg white lysozymes. *Appl. Biochem. Biotechnol.***185**, 786–798 (2018).
CAS Article Google Scholar
14. Zimoch-Korzycka, A. & Jarmoluk, A. The use of chitosan, lysozyme, and the nano-silver as antimicrobial ingredients of edible protective hydrosols applied into the surface of meat. *J. Food Sci. Technol.***52**, 5996–6002 (2015).
CAS Article Google Scholar
15. Nguyen, T.-T.-B., Chang, H.-C. & Wu, V. W.-K. Adsorption and hydrolytic activity of lysozyme on diamond nanocrystallites. *Diam. Relat. Mater.***16**, 872–876 (2007).
ADS CAS Article Google Scholar
16. Ashrafpour, S. & Tohidi Moghadam, T. Interaction of silver nanoparticles with Lysozyme: Functional and structural investigations. *Surfaces and Interfaces*, https://doi.org/10.1016/j.surfin.2017.09.010 (2017).
17. Yu, E. *et al*. Poly (N-isopropylacrylamide)-gated Fe3O4/SiO2 core shell nanoparticles with expanded mesoporous structures for the temperature triggered release of lysozyme. *Colloids Surfaces B Biointerfaces***135**, 652–660 (2015).
CAS Article Google Scholar
18. Tohidi Moghadam, T. *et al*. Interaction of lysozyme with gold nanorods: conformation and activity investigations. *Int. J. Biol. Macromol.***49**, 629–636 (2011).
Article Google Scholar
19. Gangadoo, S., Stanley, D., Hughes, R. J., Moore, R. J. & Chapman, J. The synthesis and characterisation of highly stable and reproducible selenium nanoparticles. *Inorg. Nano-Metal Chem.***47**, 1568–1576 (2017).
CAS Article Google Scholar
20. Selim, N. A., Radwan, N. L., Youssef, S. F., Eldin, T. A. S. & Elwafa, S. A. Effect of inclusion inorganic, organic or nano selenium forms in broiler diets on: 2-Physiological, immunological and toxicity statuses of broiler chicks. *Int. J. Poult. Sci.***14**, 144 (2015).
CAS Article Google Scholar
21. Cremonini, E. *et al*. Biogenic selenium nanoparticles: characterization,

antimicrobial activity and effects on human dendritic cells and fibroblasts. *Microb. Biotechnol*, https://doi.org/10.1111/1751-7915.12374 (2016).

22. Chudobova, D. *et al*. Comparison of the effects of silver phosphate and selenium nanoparticles on Staphylococcus aureus growth reveals potential for selenium particles to prevent infection. *FEMS Microbiol. Lett.***351**, 195–201 (2014).
CAS Article Google Scholar
23. Nguyen, T. H. D., Vardhanabhuti, B., Lin, M. & Mustapha, A. Antibacterial properties of selenium nanoparticles and their toxicity to Caco-2 cells. *Food Control*, https://doi.org/10.1016/j.foodcont.2017.01.018 (2017).
24. Ernest, V., Gajalakshmi, S., Mukherjee, A. & Chandrasekaran, N. Enhanced activity of lysozyme-AgNP conjugate with synergic antibacterial effect without damaging the catalytic site of lysozyme. *Artif. cells, nanomedicine, Biotechnol.***42**, 336–343 (2014).
CAS Article Google Scholar
25. Tripathy, N., Ahmad, R., Bang, S. H., Min, J. & Hahn, Y.-B. Tailored lysozyme–ZnO nanoparticle conjugates as nanoantibiotics. *Chem. Commun.***50**, 9298–9301 (2014).
CAS Article Google Scholar
26. Abouhmad, A., Dishisha, T., Amin, M. A. & Hatti-Kaul, R. Immobilization to positively charged cellulose nanocrystals enhances the antibacterial activity and stability of hen egg white and T4 lysozyme. *Biomacromolecules***18**, 1600–1608 (2017).
CAS Article Google Scholar
27. Wu, T. *et al*. Integration of lysozyme into chitosan nanoparticles for improving antibacterial activity. *Carbohydr. Polym.***155**, 192–200 (2017).
CAS Article Google Scholar
28. Yu, W.-Z. *et al*. Synergistic antibacterial activity of multi components in lysozyme/chitosan/siler/hydroxyapatite hybrid coating. *Mater. Des.***139**, 351–362 (2018).
CAS Article Google Scholar
29. Jamróz, E. *et al*. Development and characterisation of furcellaran-gelatin films containing SeNPs and AgNPs that have antimicrobial activity. *Food Hydrocoll.***83**, 9–16 (2018).
Article Google Scholar
30. Masschalck, B., Van Houdt, R., Van Haver, E. G. R. & Michiels, C. W. Inactivation of gram-negative bacteria by lysozyme, denatured lysozyme, and lysozyme-derived peptides under high hydrostatic pressure. *Appl. Environ. Microbiol.***67**, 339–344 (2001).
ADS CAS Article Google Scholar