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SELENIUM NANOPARTICLES AND ITS APPLICATION

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Abstract

Selenium is an important trace element within the diet, required for protection of health and growth; however, its toxicity could cause extreme damage depending on dose and chemical form. Selenium nanoparticles (SeNPs) represent a prospect for nutritional supplementation due to their decreased toxicity and capacity to gradually release selenium after ingestion. Selenium nanoparticles (SeNPs), as a special shape of selenium (Se) supplement, have attracted worldwide attention because of their favorable properties and unique bioactivities. A green and economic way to prepare stable SeNPs have been introduced. Selenium Nanoparticles serve to reduce the toxicity, enhance bioactivity. The aim of the present study is to analyse the properties and applications of selenium nanoparticles. Here we have discussed the significance of the selenium nanoparticles and its pharmacological activity. The role of selenium nanoparticles in pharmacological protection against various conditions is presented.

KEYWORDS: *Antimicrobial activity ; Anticancer ; Nanoparticle; Selenium; Antioxidant,*

Introduction

The word selenium originates from the greek word "selene" which refers to the moon goddess.It was discovered by Jacob Berzelius in 1858. Primarily selenium was found immobilized in the sedimentary rocks.As a nutritional supplement , Se is a necessary trace element required for the maximum of the living organisms consisting of animals and human beings. Se is given in as a minimum 25 human selenoproteins and enzymes as selenocysteine, which performs a critical position in preventing diverse diseases such as cardiovascular disease, hypercholesterolemia and sure cancers. To meet the everyday requirement of Se, more Se supplementation is necessary, in particular for those having Se deficiency. Some Se compounds in each inorganic and natural forms, along with selenite, selenomethionine and Se-methylselenocysteine, have been used for many years to keep away from Se deficiency in animals and human beings [1]

In the recent years, SeNP, a kind of elemental Se particle at a nano-size scale with a bright purple color, has aroused worldwide attention due to its unique properties and notable biological sports. It not simplest scavenges the loose radicals in vitro however additionally improves boom, serum oxidant popularity and Se awareness in vivo. Amazingly, in comparison with Se compounds which include selenite, selenomethionine, Se-yeast and Se-methylselenocysteine, SeNPs showcase much decreased acute toxicity whilst increasing the sports of

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selenoenzymes. Besides, SeNPs are able to inhibit the increase of microorganisms.They additionally show off antitumor sports *both in vitro and in vivo, by way of inducing mitochondrial-mediated apoptosis9 and stimulating immune* reaction against cancer cells. Thus, SeNPs are taken into consideration as a prospective Se formulation for dietary complement use, chemoprevention and chemical therapy towards cancer.

The review was mainly based on phases of selenium nanoparticles and its applications like, antioxidant activity, antimicrobial, antiviral effects, [1] the review focuses on its properties and the mode of supplementation. Selenium nanoparticles synthesis nano selenium and shows it's bioavailability and toxicity [2] and its intoxication and its immunomodulation helps in reproduction growth [3] Previous studies has been done by our team on various aspects that includes goitre [4], obesity [5], thyroid study [6] sleep patterns[7], neonatal jaundice [8], muscular endurance [9], physical fitness [10], asthma [11], fatty liver [12] , acupuncture [13], tongue exercise [14], expiratory flow rate [15] , myocardial infarction [16], nasal spirometry [17] , survey on onychocryptosis [18] and all that experience led us to work on current topics. The aim of the present study is to analyse and review the properties and applications of selenium nanoparticles.

PROPERTIES OF SELENIUM NANOPARTICLES :

Selenium is the essential trace element in diet maintenance and health growth has lower toxicity. They are mainly used for anticancer treatment. A huge quantity of reports suggest particular biomedical programs of SeNPs starting from antioxidant pastime to anticancer effects and are attributable especially to its redox modulatory property. However, the exact assessment of molecular outcomes of SeNPs is hitherto absent from the modern literature.In the prevailing overview, we have made an attempt to fill this hole by supplying a comprehensive survey of various pharmacological activities with emphasis on the molecular mechanism of such reported activities.In addition, the underlying mechanisms behind the discount in toxicity of Se upon nano particlization had been explored to provide a likely explanation for this precise phenomenon owing to the truth that Se is toxic and the margin of safety is very narrow.It plays a major role in the field of medicine and it also shows antibacterial properties [19–21].

APPLICATION OF SELENIUM NANOPARTICLES:

Selenium is a narrow therapeutic and very delicate and this nanotechnology driven formulation approaches hold a substantial potential in the 21st century drug delivery.These selenium nanoparticles have been explored in various pharmaceutical industries,medical field activities and various other fluids. However the interaction of selenium nanoparticles with genes and chromosomes is warranted with studies pertaining to their gene safety [19,22].

SELENIUM NANOPARTICLES AS AN ANTIOXIDANT :

Selenium (Se) is involved in the antioxidant defense systems of the liver and performs an essential role in protecting against oxidative stress [23]. Many research confirmed that Se supplementation can increase the extent of enzymes including GPx etc., prevent the accumulation of unfastened radical species, and reduce the cellular harm However, the slim margin among the effective and toxic doses constrained the application of this substance. The Se has therefore gained more attention because of its low toxicity and incredible bioavailability in comparison with Se(IV) and Se(VI), in view that each having a strong capacity to capture unfastened radicals. Nevertheless, negative water solubility and the capability to without problems rework into a gray analogue that is thermodynamically stable however biologically inert, makes Se difficult for use in food and medication fields. Nano selenium possesses better antioxidant capability than the other forms of selenium while reducing the risk of selenium toxicity. Wang et al demonstrated the antioxidant properties of selenium nanoparticles that evinced lower toxicity than selenomethionine (Se Met)[24].

ANTIVIRAL AND ANTIBACTERIAL EFFECTS OF SELENIUM:

Bacteria can easily form biofilms when they attach to a surface. A bacterial biofilm is an aggregate of one or more types of bacteria in a hydrated polymeric matrix. Biofilms are a common cause of persistent infections as they are easy to form but hard to treat. *S. aureus* biofilms have been found on a wide range of medical devices

including prosthetic heart valves, central venous catheters, urinary catheters, orthopedic prostheses, penile prosthesis, contact lenses, endocarditis, otitis media, osteomyelitis, and sinusitis. Selenium nanoparticles have attracted substantial attention due to their unique antimicrobial activity and also reported that the selenium nanoparticles are found to possess antimicrobial activity [25]. Selenium is an essential trace element regulated by cellular redox homeostasis and is an integral component of selenoproteins controlling some crucial biological process. The antiviral capability of selenium nanoparticles together with other advantages such as toxicity and excellent activity has recently attracted increased attention [26]. The high surface areas of nanoparticles allow for more active sites for interacting with biological entities such as cells. The higher surface areas of nanoparticles compared with conventional micron-size particles also offer more sites for functionalization with other bioactive molecules, such as anticancer and antibacterial drug molecules. [27].

NANO SELENIUM AS AN ANTICANCER DRUG:

Cancer is considered one of the most devastating problems of the 21st century, creating a chief challenge amongst clinicians and researchers. The ever growing trouble of drugs causing toxicity and resistance has doubled the trouble. Many different treatment strategies are being attempted to combat the battle in opposition to most cancers and a plethora of techniques have been attempted [1]. Nanotechnology has substantially improved our technique of personalized medicine whereby the focus has progressed and at the identical time the toxicity can be suppressed. Various inorganic nanoparticles were investigated to result in cytotoxicity in cancer cells and one of the successfully tried nanoparticles is SeNPs. SeNPs based methods have shown hope in fighting with the drug resistance trouble and in mitigating toxicities associated with chemotherapeutic agents. SeNPs offer a brilliant platform to ferry chemotherapeutics to the goal site. SeNPs exhibit differential activity in opposition to malignant cells and ordinary cells.Nano selenium possesses higher anticancer efficacy than other selenium compounds [27]. A key mechanism for the chemopreventive effect is the induction of glutathione S transferase (GST) by selenium. The activity of GST is increased by nano selenium administration [28].Y, Zheng et al in his study reported the synthesis of selenium nano particle using polyethylene glycol and he determined the effect of these selenium nanoparticles using polyethylene glycol on drug resistant hepg2 cell line and drug sensitive hepg2 cell lines . And also he reported that the peg coated selenium nanoparticles have greater inhibition growth of inhibition against drug resistant hepg2 cells than drug sensitive hepg2 cell lines [22].

THERAPEUTIC AND BIOMEDICAL APPLICATIONS OF SELENIUM NANOPARTICLES :

Selenium nanoparticles offer improved bioavailability with added advantages of decreased toxicity. By looking at the historical account of drug delivery, it has been surveyed that approximately 95% of all potentially critical therapeutics have reduced pharmacokinetics and bio-pharmaceutical properties. Delivery structures also offered restricted solubility and bad selectivity and reduced quantity of drug diffusion through biological obstructions which leads to unfavorable effects. The fundamental diffusion limitations include Cellular Membrane, reticuloendothelial barriers, Endothelial barriers, Blood brain barrier, Blood tumor barrier, Multi drug resistant tumor cells.

Consequently, successful deliverance of therapeutics to infection positions is a major struggle in biomedicine.Therefore, there is a need to develop suitable drug delivery ways that distribute the therapeutically energetic drug particles to the web page of action, without affecting healthful organs and tissues.Nanoparticles,especially selenium nanoparticles, play a vital role in healing procedures of destiny as “nanomedicines” for most cancers. The pro- oxidant as well as the antioxidant effects provide different avenues for exploration in a variety of pathological conditions [29].

DISCUSSION:

Selenium is an important element that interferes through selenoproteins in many physiological processes of the organism and affects the production and reproductive properties [30][31]. These biomolecules used to reduce Se salts in-Vitro [32] are the byproducts released in the environment may be hazardous and affects the flora and fauna.Therefore we analysed in depth on the biogenic synthesis of Se nanoparticles and their characterisation and transformation into t-Se, m-Se, Se nanoballs, Se-nanowires] in an innocuous way preventing the

environment from population.Recently found that the dietary nano Se supplementation increases the activity of GP and CAT in erythrocytes of layered chicks. These findings indicated that nano selenium has higher selenium retention in the liver, pancreas and the breast muscle than dietary selenium. The use of SENPS for the therapeutic purposes, many scientific studies suggested that many of these generally prevailing doubts have not been confirmed. However it is still necessary to carry out further preclinical studies.

CONCLUSION:

From the present study, Se is an essential element with pleiotropic pharmacological properties, activities. In the present review we highlighted the importance of SENPS over their elemental counterparts. This Se nanoparticles technology provides attractive characteristics with a variety of possible biomedical applications. The biotherapeutic relevance of SENPS has unwrapped innovative opportunities for biotechnology engineering-fabrication of superior and effective diagnostic and remedial creations for biomedical functions.

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AUTHORS CONTRIBUTION:

All the authors contributed equally in concept , design, carrying out the analysis and review of the study.

CONFLICT OF INTEREST:

The authors have none to declare

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