MINAR International Journal of Applied Sciences and Technology
ISSN: 2717-8234
Article type: Research Article

Received: 28/03/2022 **Accepted:** 22/04/2022 **Published:** 01/06/2022

THE DANGERS OF SILVER NANOPARTICLES TO THE HUMAN BODY AND THE ENVIRONMENT

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Abstract

Nanotechnology is a rapidly growing science of producing and utilizing nano-sized particles that are procedure in nanometers. These nanomaterials are already having an impact on health care for the time being, nanoproducts are used to in various fields. Among the use are silver nanoparticles playa major role in the field the nano revolution and nanomedicine. Nanoparticles with is small size to large surface area (1–100 nm) have potential medical, industrial and agricultural applications. Scientists have carried out significant efforts toward the synthesis of nanoparticles by different means, including physical, chemical and biological methods. These properties can be used to overcome some of the limitations found in traditional therapeutic and diagnostic agents. What makes these materials superior and indispensable a their unique size-dependent properties. Silver nanoparticles have potential antimicrobial activity towards many pathogenic microbes. Along with this antimicrobial activity, silver nanoparticles are showing unacceptable toxic effects on human health and the environment.

Keywords: Silver Nanoatoms, Negative impact, Polymers, Environmental Hazardous, Toxicity.

http://dx.doi.org/10.47832/2717-8234.11.1

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Introduction

Nanoparticles are defined as particles in a size between (1 and 100 nm) the show properties that are not found in bulk samples of the same material[1]. These days, nanotechnology usage has spread all over the world, especially with its impact on healthcare as well as many another fields. Materials in the nanometer size range may possess unique and beneficial properties, which are very useful for different medical applications including stomatology, pharmacy, and implantology tissue engineering. The application of nanotechnology to medicine, too known as nanomedicine, concerns the use of precisely engineered materials at this length scale to develop novel therapeutic and diagnostic modalities [2]. Silver is a naturally active precious metal, most often as a mineral ore in association with other materials. It has been positioned as the 47th element in the periodic table, having in atomic weight of 107.8, and two natural isotopes 106.90 Ag and 108.90 Ag with in abundance with 52 and 48%, straight. It has been used in a wide variety of applications as it has some special properties like high electrical and thermal conductivity (Nordberg and Gerhardsson 1988)[3]. Ancient civilizations used this precious metal in medicine, eating utensils, plates, cups, food containers, jewellery, money/coins, clothes, building materials, and as a disinfectant for water and human hit Nanoatoms have unique physicochemical properties, such as straight small size, large surface area to mass ratio, and high reactivity, which are different from bulk materials of the same composition[4]. Polymeric and ceramic nanoparticles have been extensively studied as particulate carriers in the pharmaceutical and medical fields because they show promise as drug delivery systems as a result of their controlled- and sustained-release properties, subcellular size, and biocompatibility with tissue and cells. Silver compounds may produce many toxic effects like liver and kidney damage, irritation of the eyes, skin, respiratory and intestinal tract, and changes to blood cells[5]. This review summarizes the hazardous effects of silver nanoparticles in the environment and their toxic effects on human life [6] .

2. WHAT IS NANOSILVER?

Nanosilver is a commercial name for pure de-ionized water with superfine silver in suspension[7]. in nanoparticles size an averag from 5 to 50 nm. Most of the silver is in the form of metallic silver nano-particles. The remaining silver is in ionic form. Because of the small size of the particles, the total surface area of the silver exposed in solution is maximized, resulting in the highest, possible effect per unit of silver (Alt et al. 2004)[8]. As a result, a very small concentration of silver in NanoSilver provides greater effectiveness inside the body than silver solutions in the colloidal form of many times greater concentration. Nano-silver products are characterized by high percentage of silver metallic form. This is important because ionic silver becomes silver chloride in the stomach or bloodstream. thes solubility of silver chloride is low. In addition, the silver chloride is less effective than metallic silver. Only metallic particles survive the hydrochloric acid of the stomach to remain effective inside the body [9] .

3. Literature review

Silver nanoparticles are the most common commercialized nano technological product on the market. Due to its unique antibacterial properties, silver nanoparticles have been hailed as a breakthrough germ killing agent and have been incorporated into a number of consumer products such as clothing, kitchenware, toys and cosmetics, Many consider silver to be more toxic than other metals when in nanoscale form and that these particles have a different toxicity mechanism compared to dissolved silver. Scientists have concluded that nanoparticles can pass easily into cells and affect cellular function, depending on their shape and size. However, little has been done to evaluate these interactions and their health impacts on humans. [10]. Nanotechnology is showing promising developments in many areas and may benefit health body and welfare. However, a wide range of ethical issues has been raised by this innovative science. Many authorities believe that these advancements could lead to irreversible disasters if not limited by ethical guidelines.

Recently, nanoparticles have been widely used in biomedical applications due to their specific physical and chemical properties which alter the normal biological activity, as compared to bulk materials. The rise in the use of nanoparticles in this field, therefore, raises concern over the impact the such particles may have in the health body so its the requires the establishment of new regulations or adaptation of previous ones, based on a new definition of what needs to be regulated . Such a science-based definition must be developed by several national and international standardization bodies, as well as organizations and authorities, to have a definition that is broadly applicable to regulatory legislation. Like everything else, the use of nanoparticles in biological systems has several aspects, both positive and contradictory. Undoubtedly, the size with nanootomes and the syunthetic methods influence the ease with which they come into biological systems and interact with tissues or cells. Many studies show the close relationship between these two variables, size, and shape, and analyze the ease with which such nanoparticles circulate or accumulate within a living, special sites of sedimentation, and the time it takes for nanoparticles to saturate the system and promote cell functional failures. Nanoparticles move freely within a cell and can therefore interact with proteins, lipids, and other components [11] .

Numerous methods have been adopted for the synthesis of AgNPs to meet these increasing requirements. The conventional physical method of synthesis includes spark discharge and pyrolysis [12]. A chemical method that can be a top-down or bottom-up approach involves three main components: metal precursors, reducing agents, and stabilizing/capping agents [13]. The common approach is usually over chemical reduction by organic or inorganic reducing agents, such as sodium citrate, ascorbate, sodium borohydride, elemental hydrogen, polyol process, tollens reagent, N, N-dimethylformamide, and polyethylene glycol-block copolymer [14]. Other procedures include cytochemical synthesis, laser ablation, lithography, electrochemical reduction, laser irradiation, sono-decomposition, and thermal to divide [15]. The major advantage of the chemical method is its high yield, unlike the physical method which has a partly low yield [15]. However, contrary to the physical method, the chemical method is extremely expensive, toxic, and hazardous [16]. To overcome the final limitations, the biologically-mediated synthesis of NPS has emerged as a better alternative. This simple, cost-effective, and environment-friendly approach uses biological systems including bacteria, fungi, plant extracts, and small biomolecules like vitamins, amino acids, and enzymes for the synthesis of AgNPs. The green approach is widely accepted due to the availability of a vast array of biological resources, a decreased time requirement, high density, stability, and the ready solubility of prepared NPs in water [17].

You should The characterization of AgNPs is a very crucial step to evaluate the functional effect of synthesized particles [18]. It has been documented in various studies that the biological activity of AgNPs depends on morphology, structure, size, shape, charge and coating/capping, chemical composition, redox potential, particle dissolution, ion release, and degree of aggregation [19,20,21,22,23]. Like all other NPs, these parameters can be determined by using various analytical techniques, such as dynamic light scattering (DLS), zeta potential, next to advanced microscopic techniques.

Characterization of AgNPs the like atomic force microscopy scanning electron microscopy (SEM) and transmission electron microscopy (TEM), UV-vis spectroscopy, X-ray diffractometry (XRD), Fourier transform infrared spectroscopy (FTIR), and X-ray photoelectron spectroscopy (XPS) [24,25]. To capture the concept of the importance of AgNPs characterization, it must be noted that from a toxicological perspective, studies that used similar AgNPs provided by the same manufacturer demonstrated different results. For example, a repeated exposure study by Vandebriel RJ et al [26] . in rats showed that AgNPs are cytotoxic to various cells. On the other hand, Boudreau M.D[27] the used similar particles, apparently the dose-dependent accumulation of AgNPs in various tissues of rats, without causing significant cytotoxicity. Moreover, some published nanotoxicity studies have reported a characteristics of the particles by using a manufacturer's data just one, without investigators to confirm their found characteristics, or by using a single analytical tool that provides limited information about the particle type being studied [28]. This brings in the importance of the adequate physicochemical characterization of AgNPs before undertaking toxicity assessment studies. In addition, a standardized measurement approach like the application of validated methods and the use of reference materials that are specific to AgNPs needs to be more developed to assure the comparability of results among toxicity studies that used similar AgNPs.

- **Synthesis of AgNPs.**

Metals (Au, Ag, etc.), metal oxides (ZnO, TiO2, SiO2, Fe3O4, etc.) and metal composites, are the inorganic functional materials with exceptional optical [5–9], electrical and magnetic properties [29,30]. Green synthesis of AgNPs is a very simple and cost-effective approach that meets the demand of the research community and simultaneously rejects the possibility of ecological risks [31]. This review looks to offer superior opportunities of biosynthesis silver nanoparticles (NPs) which have been the topics of researchers due to their unique attributes (e.g., size and shape depending optical, antimicrobial, and electrical properties) [32]. Top-down and bottom-up are the two synthesis approaches of metallic nanoparticles involves by chemical, physical, and biological means. The usual production of nanoparticles involves physical and chemical processes. Both approaches apply for the synthesis of AgNPs. The mechanical grinding of bulk metals and subsequent stabilization of the resulting nanosized metal particles by the addition of colloidal protecting agents are some examples of the top-down method. Besides the bottom-up method, include the reduction of metals, electrochemical methods, and decomposition [33]. In this section, we introduce the overview preparation of silver nanoparticles using physical, chemical, and biological synthesis is highlighted.

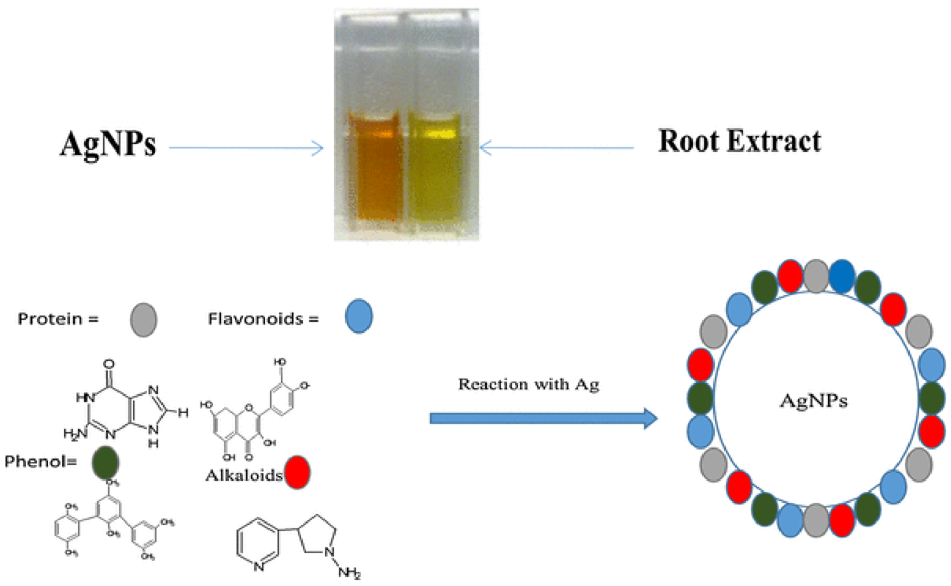

Figure (1) Synthesis-of-silver-nanoparticles-AgNPs

4. Toxic Effects Of NaOosilver Or Silver On Health.

Silver has potentially toxic effects on a human health it can enter into the human body through various portals[34]. Previous literature indicated that Ag+ causes early changes in the permeability of the cell membrane to K+ and then to Na+ at concentrations that do not limit Na+ , K+ -ATP activity or mitochondrial function. Silver does not only cause dermal and cosmetic toxic effects, but also it causes death in animals. shown that silver nanoparticles can be nearly 50% more toxic than chrysolite asbestos[35]. Nanoparticles, such as silver nanoparticles, are showing severe toxic effects on the male reproductive system. The identified research suggests that nanoparticles cross the blood-testes barrier and are deposited in the testes, and that there is potential for adverse effects on sperm cells [36].

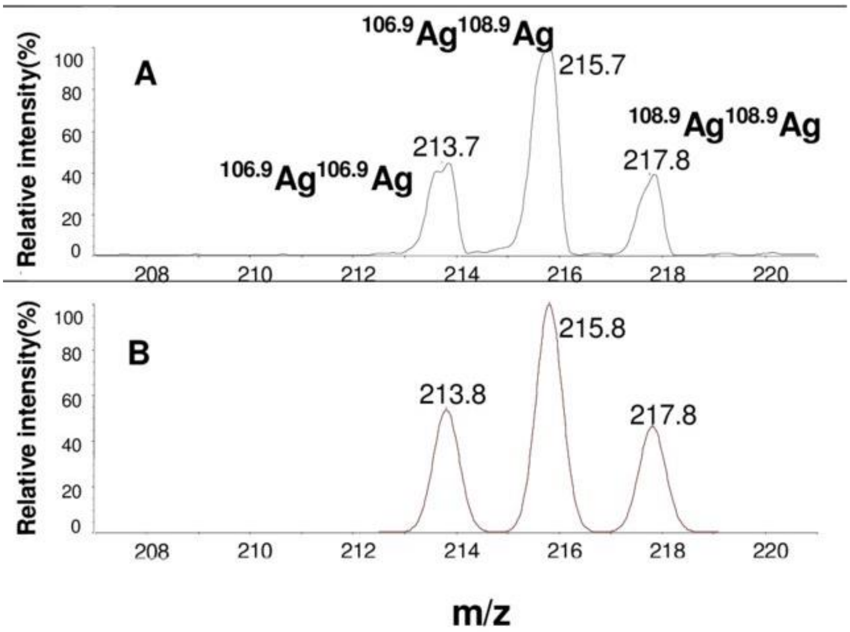

Fig. 2. Experimental (A) and theoretical (B) mass spectra of Ag2 + cluster cation.

thes commercial MALDI-TOF MS instrument (Axima-CFR, Schimadzu biotech, Japan) with a pulsed nitrogen laser of a wavelength of 337 nm was used for laser desorption ionization of silver nitrate with an addition of trifluoroacetic acid. Conditions: the linear-positive mode [37].

As per the existing literature, it has been demonstrated that silver nanoparticles show intensive toxic effects on the proliferation and cytokine expression by peripheral blood mononuclear cells (PMBCs) [38] At levels of over 15 ppm, nano-silver was found to have a significant cytotoxic effect on PBMCs, and Phytohaemagglutinin-induced cytokine production was significantly inhibited by nano-silver. In the ajob of Burd et al. (2007) [39] , it was demonstrated that commercially available silver-based dressings also appears potential cytotoxic effects.

5. The Impact of Nanoparticles on the Environment

Silver in the environment comes from its many uses in industry, in medical applications, in water disinfection, and in consumer products. Silver as nanoparticle represents only a small fraction of the total amount of silver that enters into the environment[40]. However, silver in this form may be more readily absorbed by some species, posing a potential problem. In Europe, silver compounds from textiles and cosmetics have the greatest environmental exposure when the water a used to wash or rinse them off is handled at wastewater treatment plants. Subsequent silver release from these wastewater treatment plants to ground and surface waters is expected to be low. Nevertheless, the silver release at certain concentrations that are found to be toxic to some aquatic organisms is possible, next to unlikely[41].

Conclusion

Nanotechnology deals with the nanoparticles having a size of 1-100 nm. Biological synthesis showed the good capability to the synthesis of silver nanoparticles. From the technological point of view, the silver nanoparticles have wide potential applications in the biomedical field, healthcare, environmental bioremediation, medical and pharmaceutical applications. Silver nanoparticles are also found to be very effective catalysts. They have the ability to degrade textile dyes. The catalytic activity can be controlled by controlling the size of the nanoparticles. Silver nanoparticles show variable applications so that these can be used in advanced portable gadgets and also can be used in the production of cloths, leather items, and coating because silver nanoparticles can protect these items from the attack of various harmful microorganisms. Thus, use of silver nanoparticles is a cost-effective, less time consuming and we can explore the other hidden applications of silver nanoparticles.

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