World Journal of Environmental Biosciences
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Available Online at: **www.environmentaljournals.org**

Volume 6, Supplementary: 6-8

ISSN 2277- 8047

An Investigation about Bio Physical Properties of Silver Nanoparticles Produced by Chemical Methods

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ABSTRACT

Silver Nanoparticles by the purpose of applying in medical physics and investigation about their effect on aquatic Environment were produced by chemical method. X-ray diffraction (XRD), Scanning electron microscopy (SEM) and Energy Dispersive X-ray spectroscopy (EDAX) analysis proved the production of Silver Nano particles with fractal, flower like structures and dominant face-centered cubic structure. There is a big challenge about influence and effect of silver Nano particles by researchers.

Keywords: *influence effect, Silver, Nano particles, Aquatic Environment.*

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INTRODUCTION

The emergence and increase in antibiotic resistance is an alarming concern in clinical diseases in both human medicine but veterinary medicine. Due to the increase in the outbreak of bacterial diseases in the aquaculture industry and development of bacterial resistance, new antibacterial agents are required. One possibility is to use Nanoparticles as antimicrobial drugs. The most common Nanomaterial mentioned in consumer product inventories is silver. It is well recognized that silver (Ag) Nanoparticles possess potential antibacterial properties against a wide range of bacteria (Rai, M., Yadav, A., Gade, A, 2009). Silver Nanoparticles showed antimicrobial effects against fish pathogens (Kim, J. S., Kuk, E.,Yu,K. N., Kim, J. H., Park, S. J., Lee, H. I., Kim, S. H., Park, S. J., Park,Y. H., Hwang, C. Y., Kim, Y. K., Lee, Y. S., Jeong, D. H., Cho, M. H, 2007). However, studies pertaining to the antibacterial effects of Ag Nanoparticles in vivo are not exploited. Though, Ag Nano particles are promising bactericidal agents, Ag-induced toxicity limits the use of Ag Nano particles. Silver Nano particles (Ag NPs) are also widely utilized in material science, chemistry and physics fields due to their particular magnetic, optical, electronic, and catalytic properties. For instance, a very small concentration of silver in Nano silver provides greater effectiveness inside the body than bulk silver solutions in the colloidal form of many times greater concentrations (Panyala NR, Pena-Mendez EM, Havel J, 2008). It has been shown that silver ion (Ag^+) toxicity for fish is significantly less toxic in salt water than in fresh water (Wood M, Broyda S, 2004). This difference is due to the high ionic strength that creates links between free silver ions and anions in the salt water (Ward TJ, Kramer JR, 2002) and also the competition for gill binding sites between Ag^+ and other metallic ions. The biomedical applications of silver nanoparticle can be effective by the use of synthesized Nanoparticles which minimize the factors such as toxicity and cost and are found to be exceptionally stable like other Nano materials. Hence the development of better experimental procedures for the synthesis of nanoparticles of different chemical compositions, sizes, shapes and controlled poly disparity is vital for its advancement. The aim of this work is to synthesis Ag Nanoparticles and investigated about their Nano structure and crystalline properties by XRD, SEM and EDAX analysis to improve the researches that study the influence and effect of Ag Nanoparticles in aquatic Environment.

- **Action of silver Nano particles on aquatic organisms**

There is still little knowledge on how Ag NPs interact with aquatic organisms and major questions remain to be examined. It is generally not known whether assessed toxicity results from internalization of particles in cells of exposed organisms (Chae YJ, Pham CH, Lee J, Bae E, Yi J, Gu MB, 2009). While Ag^+ has been shown to explain toxicity to bacteria and algae and partly to other organisms too, other studies show that exposures to ionic and particulate Ag result in distinct transcriptional response (Farkas J, Christian P, Urrea JA, Roos N, Hassellöv M, Tollefsen KE, et al, 2010). While environmental studies indicate the susceptibility of Ag NPs to be transformed as a function of pH, ionic strength and chemicals occurring in the environment, no attention has been given to the biological transformation of Ag NPs and their influence on NP uptake and toxicity once particles come in contact with aquatic organisms, or after their internalization. Determining the bioavailability, uptake and intracellular accumulation of Ag NPs in aquatic organisms is essential for the evaluation of their toxicity to aquatic (Panyala NR, Pena-Mendez EM, Havel J, 2008). Intracellular, Ag NPs were found to be localized mainly in endosomes as well as in lysosomes, where they occur as aggregates [Wood M, Broyda S, 2002]. In the same study, the finding that Ag from exposures to $AgNO_3$ was mainly found to be associated with metallothionein and was taken as indirect evidence that detected particles

correspond to the Ag NPs to which the organisms were exposed (Ward TJ, Kramer JR, 2002). In typical research, effects of aqueous exposure to silver Nanoparticles in Rainbow Trout were investigated (Takenaka S, Karg E, Roth C, Schulz H, Ziesenis A, Heinzmann U, Schramel P, Heyder J, 2011). They used silver particles in three nominal sizes: 10 nm (N_{10}), 35 nm (N_{35}), and 600–1600 nm (N_{Bulk}). These Nano particles were uptake into the gills, liver, and kidneys of Rainbow Trout for 10 days. Figure 1 shows the TEM images of gill tissue dissected from Rainbow Trout after water borne exposure to 100 µg/l N_{10} silver particles for 10 days. After 10 days they measured the silver concentration in the gills, liver, and kidney. Their experimental show that exposure of silver NPs to rainbow trout can result in accumulation of silver in the gills and liver of fish and can affect likely oxidative metabolism in the gills.

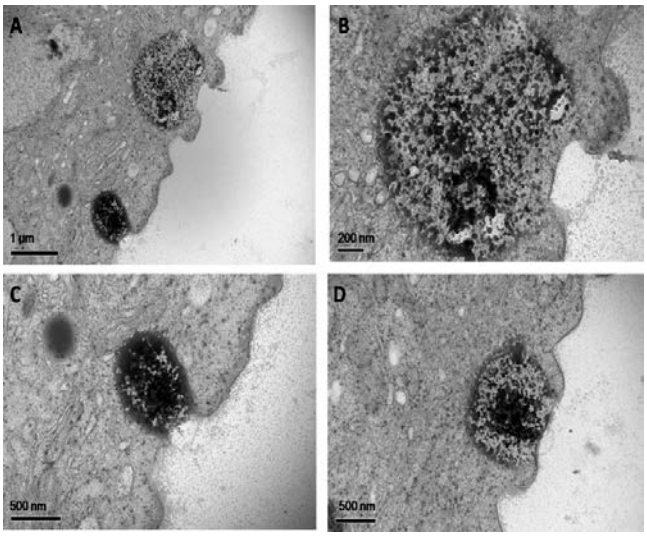

Figure 1: TEM images of gill tissue dissected from rainbow trout after water borne exposure to 100 µg/l N_{10} silver particles for 10 days. Images (A) and (D) show aggregates at the edges of the gill tissue, images (B) and (C) are higher magnification images of aggregates in image (A) (Takenaka S, Karg E, Roth C, Schulz H, Ziesenis A, Heinzmann U, Schramel P, Heyder J, 2001).

3. Experimental Details

Silver Nano particles prepared by chemical method. The aqueous solution (40 ml) containing glucose (7 mmol), polyvinyl pyrrolidone (12 mmol), and sodium hydroxide (7 mmol) has been heated at 50°C for 60 min under vigorous stirring at 2000 rpm. After that, 20 ml aqueous solution of $AgNO_3$ (1 mol/l) has been dropped in the previous solution. After refluxing for 60 min, the colloidal solution has been allowed to cool slowly to room temperature. The resultant solution has been under taken to centrifugation at 6000 rpm for 90 min. After filtration, the precipitate so obtained has been washed many times with deionized water using centrifugation for 15 min each time. Finally, the precipitate has been collected and powdered finely.

Crystal and phase structure of the deposited Ag Nano particles were identified using an X-Ray X-pert MPD diffractometer (CuKα radiation, λ=0.15406 nm) with step size of 0.03 and count time of 1s per steps. Nano structures and element analysis were investigated by SEM (S-3400, Hitachi, .(Japan

RESULTS AND DISCUSSION

Figure 2 shows the X-ray diffraction pattern of Ag Nanoparticles deposited by chemical method.The presence of peaks at 2θ values 38.1°, 44.09°, 64.36°, 77.29° and 81.31 corresponds to (111), (200), (220), (311) and (222) planes of silver, respectively. Thus, the XRD spectrum confirmed the crystalline structure of silver nanoparticles. No peaks of other impurity crystalline phases have been detected. All the peaks in XRD pattern can be readily indexed to a face-centered cubic structure of silver as per available literature (JCPDS, File No. 4-0783). Micro-strain in the silver lattice was negligible.

Noisy XRD pattern relates to glass plate that we put Nano particles on to it for X-ray analysis.The crystallite size is : estimated from FWHM of these peaks using the Scherer's) Kangarlou H, Nasseri L ,Tohidi T, 2012 formula (

(1)

Where, D is the crystallite size, k is a constant taken to be 0.94, β is the full width at half maximum (FWHM) and λ is the wave length of the x-rays. Strains for Nano particles calculated from FWHM of prominent peaks using the relation:

(2)

The value of strain and grain size is shown in table I.

Table I: General characteristics of Ag particles

Cluster size (m)	Strain (%)	Grain size (nm)
0.9	0.34	32.3

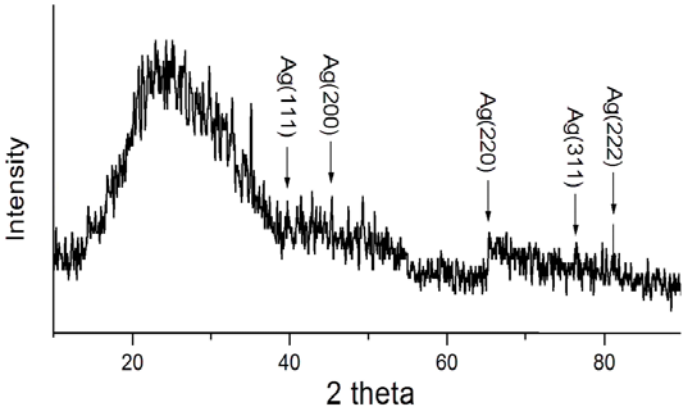

Figure 2: XRD pattern of Silver Nano particle deposited by chemical method.

The Nanostructure of Ag Nano particles are investigated by using Scanning electron microscopy which is an important technique to study structures at the Nano scale. Figure 3 shows the SEM image of produced SilverNano particle in this work. As it can be seen, Nano silvers grow as flowers and they have fractal structures. Voids between them are clear and seems .as black holes

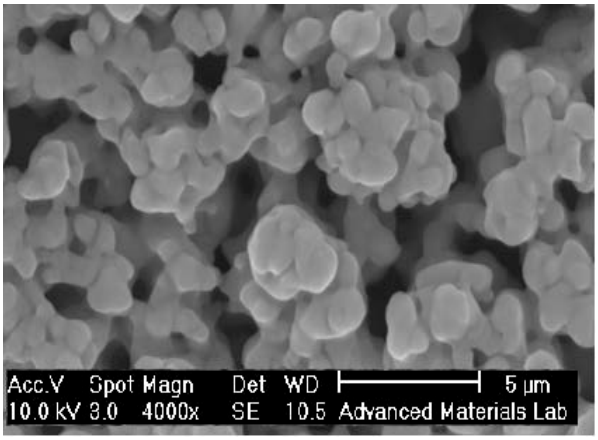

Figure 3: The SEM image of SilverNanoparticle deposited by chemical method.

We depict to element analysis of produced Nano particles as EDAX analysis in figure 4. Result approves the configuration of Silver Nanoparticles. Present of impurities as Si, O and etc because of using .chemical deposition method is inevitable

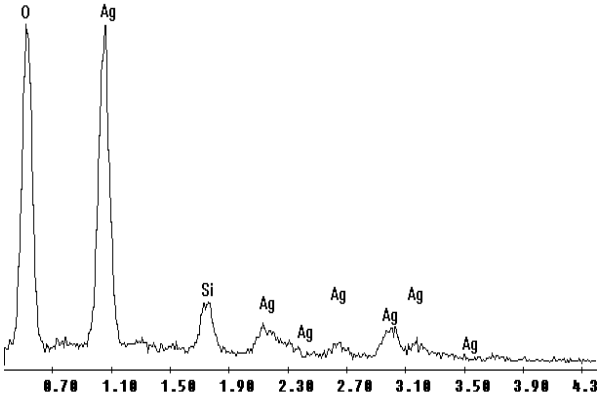

Figure 4: The EDAX graph of Silver Nano particles deposited by chemical method.

5. CONCLUSIONS

To understand the toxic potential of Ag NPs, it is essential to production of Ag NPs and understands their structural properties. Dissolution, which is of primary importance for Ag bioavailability, is very much influenced by the pH and the presence of strong binding ligands, which is completely different in various deposition methods. Structural properties such as grain size, shape of Nanoparticles, density of Nanoparticles is one important point for each study with Ag NPs and lead to more comprehensive understanding of the potential of Ag NPs for further applications. Silver Nano particles by the purpose of applying in medical physics and investigation about their effect on aquatic Environment, were produced by chemical method. Aqueous solution contains Silver nitride. X-ray diffraction(XRD), Scanning electron microscopy (SEM), Energy dispersive X-ray spectroscopy (EDAX) analysis proved the production of silver Nano particles with fractal, .flower like structures and dominant cubic crystal lattices

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