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Synthesis of plant mediated silver nanoparticles using *Nelumbo nucifera*

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Abstract

Biosynthesis of nanoparticles by plant extract is currently under exploitation. The present study deals with the synthesis of silver nanoparticles using flower extract of *Nelumbo nucifera*. The extracellular synthesis of silver nanoparticles occurred during the exposure of flower extract to 1 mM aqueous silver nitrate solution. Complete reduction of silver ions was observed after 48 h of reaction at 30ºC under shaking condition. The colour change in reaction mixture was observed during the incubation period, because the formation of silver nanoparticles is able to produce particular colour in the reaction mixture due to their specific properties of surface piasmon resonance. Formation of silver nanoparticles was confirmed by UV-Visible spectroscopy, X-ray diffraction pattern, Scherrer's formula and Fourier transform infra-Red (FT-IR) spectroscopy analysis. They showed that the synthesized silver nanoparticles were capped with bimolecular compounds from flower extract of *Nelumbo nucifera*.

Keywords: bioreduction, FT-IR, *Nelumbo nucifera*, silver nanoparticles, XRD

INTRODUCTION

A growing sense of excitement is in the life sciences, especially biomedical devices and biotechnology with regard to nano-particles (Landsdown *et al*., 2007) Nanoparticles exhibit completely new or improved properties based on specific characteristics such as size, distribution and morphology (Cao *et al.*, 2001). The silver nanoparticles have varied and important applications. The need for biosynthesis of nanoparticles rose as the physical and chemical processes were costly. So in the search of for cheaper pathways for nanoparticle synthesis (Marambiojones *et al.*, 2010), scientists use microorganisms and their plant extracts for their synthesis. Nature has devised various processes for the synthesis of nano- and micro- length scaled inorganic materials which have contributed to the development of relatively new and largely unexplored area of the biosynthesis of nanomaterials (Mohanpuria *et al*., 2007).

The advantage of using plants for the synthesis of nanoparticles is that they are easily available, safe to handle and possess a broad variability of metabolites that may aid in reduction (Baker *et al.*, 2005). A number of plants are being currently investigated for their role in the synthesis of nanoparticles. Gold nanoparticles with a size range of 2- 20 nm have been synthesized using the live *Alfa alfa* plants (Torresday *et al.*, 2002). Nanoparticles of silver, nickel, cobalt, zinc and copper have also been synthesized inside the live plants of *Brassica juncea* and *Hrlianthus annus*. Certain plants are known to accumulate higher concentrations of metals compared to others and such plants are termed as hyperaccumulators (Belly *et al.,* 1982). Of the plants investigated, *Brassica juncea* had better metal accumulating ability and later assimilating it as nanoparticles (Bali *et al.*, 2006).

Recently much work has been done with regard to plant assisted reduction of metal nanoparticles and the respective role of phytochemicals (Wong *et al.,* 2006). The main phytochemicals responsible have been identified as terpenoids, flavones, ketones, aldehydes, amides and carboxylic acids in the light of IR spectroscopic studies (Bar et al., 2009). Mainly the water soluble phytochemicals such as flavones, organic acids and quinones are responsible for immediate reduction. Most of the natural processes also take place in the nanometer scale regime (Sharma et al., 2009).

Nelumbo nucifera (India lotus) is the national flower of India and Vietnam. The roots of the plant are firmly planted in the soil of the pond or river bottom. The plant contains a number of alkaloids, raffinose and stachyose from rhizomes, nelumoside from leaves, nornucciferine, pronuciferin, roemerine, nuciferine, anonaine etc, from leaves and seeds.

MATERIALS AND METHODS

Preparation of flower extract

Fresh and young flower samples of *Nelumbo nucifera* were collected, washed thoroughly with sterile double distilled water (DDW) and surface sterilized with 0.1% $HgCl_2$ for2-3 min under the hood of laminar air flow. Twenty grams of sterilized flower samples were taken and cut into small pieces. Finely cut flowers were placed in a 500ml Erlenmeyer flask containing 100ml of sterile Double Distilled Water (DDW). After that the mixture

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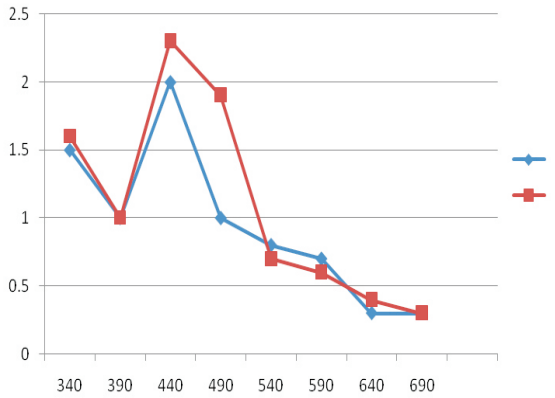

Figure 1. UV – Visible spectra analysis of silver nanoparticles

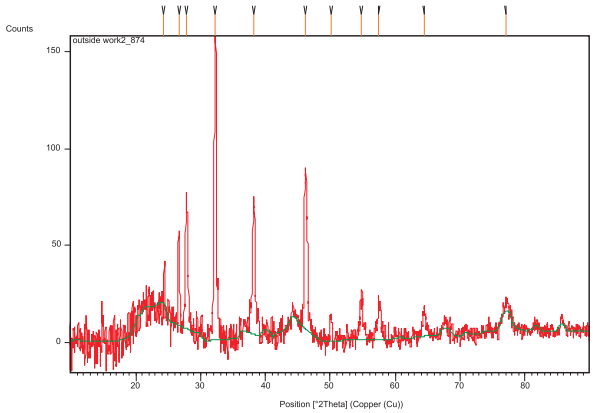

Figure 2. XRD of silver nanoparticles

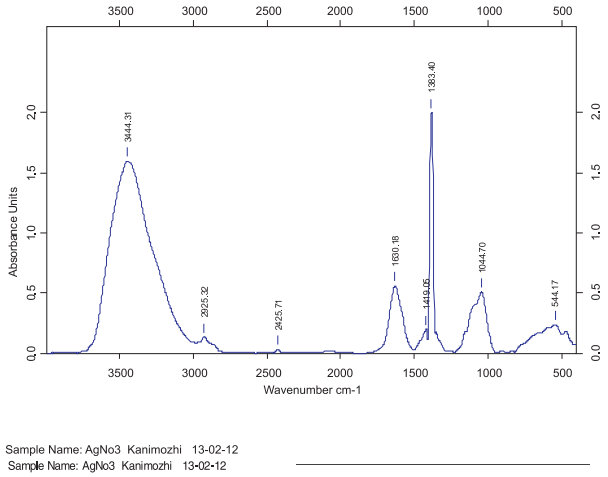

Figure 3. FT-IR Spectrum of silver nanoparticles

was boiled for 5 min and filtered. The extract was stored at 4°C.

Synthesis of silver nanoparticles

Silver nitrate was used as the precursor in the synthesis of silver nanoparticles. Five ml of flower extract was added to 100ml of 1mM $AgNO_3$ (99.99%) aqueous solution in a conical flask of 250 ml at room temperature. The flask was thereafter put into shaker (150 rpm) at 30°C and reaction was carried out for a period of 48h.

UV-Visible spectroscopy analysis

The colour change in reaction mixture (metalion solution + flower extract) was recorded through visual observation. The bioreduction of silver ions in aqueous solution was monitored by periodic sampling of aliquots (1ml) and subsequently measuring UV-Vis spectra of the solution. UV-Vis spectra of these aliquots were monitored as a function of time of reaction on Elico UV-Vis spectrophotometer (model S3-159) operated at a resolution of 1nm (Udaya soorian *et al.,* 2011).

XRD measurement

The sample was drop-coated onto aluminum plate by just dropping a small amount of sample on the plate frequently and allowing to dry that finally prepared a thick coat of sample. The XRD measurement was performed on an instrument operated at a voltage of 20 to 30 KV and a current of 30 mA with Cu K á radiation with a wavelength of 1.5418A.

FT-IR measurement

FT-IR measurement of sample was performed using. FT-IR spectrophotometer in a diffuse reflectance mode at a resolution of 4 cm^{-1} in KBr pellets.

RESULTS AND DISCUSSION

UV-Vis spectroscopy analysis showed that the SPR absorbance band of silver nanoparticles synthesized using *Nelumbo nucifera* flower extract centered at 440 nm and steadily increased in intensity as s function of time of reaction without any shift in the peak wavelength (Fig1). The frequency and width of the surface plasmon absorption depends on the size and shape of the metal nanoparticles as well as on the dielectric constant of the metal itself and the surrounding medium. Pattern obtained for silver nanoparticles showed a characteristic peak near the 2è value of 32.28 (Fig 2). A Bragg reflection corresponding to the sets of lattice planes was observed, which may be indexed based on the face-centered cubic (fcc) structure of silver. The XRD pattern thus clearly showed that the silver nanoparticles are crystalline in nature. In addition to the Bragg peak representative of fcc silver nanocrystals, additional and yet unassigned peaks were also observed suggesting that the crystallization of bio-organic phase occurs on the surface of the silver nanoparticles.

FT-IR analysis revealed that the carbonyl group from amino acid residues and proteins from the extract of *Nelumbo nucifera* had a strong ability to bind metal indicating that the proteins could possibly form a layer covering the metal nanoparticles to prevent agglomeration and thereby stabilize the medium (Fig 3). This suggested that the biological molecules

could possibly perform dual functions of formation and stabilization of silver nanoparticles in the aqueous medium.

The nanoparticles were primarily characterized by UV-Visible spectroscopy, which was proved to be a very useful technique for the analysis of nanoparticles. In the present study UV-vis spectroscopy analysis showed that the SPR absorbance band of silver nano particles synthesized using *Nelumbo nucifera* flower extract centered at 440 and stedily increased in intensity as a function of time of reaction without any shift in the peak wavelength. FT-IR analysis confirmed that the bio-reduction of Ag ions to silver nanoparticles synthesized *via* green route that are highly toxic to multidrug resistant bacteria. Hence it has a great potential in bio medical application. The biosynthesized silver nanostructure by employing *Nelumbo nucifera* extract was further demonstrated and confirmed and characteristic peaks were observed in the XRD image and the structural view under the scanning electron microscope. The XRD pattern showed three intense peaks in the whole spectrum of 2è value ranging from 10 to 80. The typical XRD pattern reveled that the sample contains a mixed phase (cubic and hexagonal) structure of silver nanoparticles.

CONCLUSION

The aqueous silver ions exposed to the *N. nucifera* extracts, the synthesis of silver nanoparticles were confirmed by the change of colour of plant extracts. These environmentally benign silver nanoparticles were further confirmed by using UV-Vis spectroscopy, XRD, FT-IR. Nano-disks of uniform thickness could be grown up to a micron size. In the present study we found that flowers of *N. nucifera* were good sources for the synthesis of silver nanoparticles. This has many advantages such as ease with which the process can be scaled of, its economic viability and in obtaining smaller particle size.

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REFERENCES

Baker, C., Pradhan, A., Pakstis, L., Pochan, D.J. and Shah, S.I. 2005. "Synthesis and Antibacterial Properties of Silver Nanoparticles", *J. Nanosci. Nanotechnol*., 5, 224-249,

Bali, R. Razak, N. Lumb, A. & Harris, A.T. 2006. The synthesis of metal nanoparticlesinside live plants. *IEEE Xplore* DOI 10.1109/ICONN. 2006. 340592.

Bar, H., Bhui, D.K., Sahoo, G.P., Sarkar, P., De, S.P. and Misra, A. 2009. Green synthesis of silver nanoparticles using latex of *Jatropha curcas*. *Colloids Surf A: Physicochem. Eng. Asp,* 339: 134–139.

Belly, R. T., and G. C. Kydd. 1982. Silver resistance in microorganisms. Dev. *Ind. Microbiol*. 23:567-577.

Cao, Y.W., Jin, R. and Mirkin C.A., 2001 "DNA-Modified Core-Shell Ag/Au Nanoparticles", *J. Am. Chem. SOC*, 123, 7961-7962,

Landsdown, A.B., A. Williams. 2007.*J Wound Care*. 16, 15

Marambio-Jones C, Hoek E.M.V., 2010, A review of the antibacterial effects of silver nano materials and potential implications for human health and the environment *J. Nanopart. Res,* 12, 1531-1551.

Mohanpuria, P.; Rana, K.N. & Yadav, S.K. 2007. Biosynthesis of nanoparticles:technological concepts and future applications. *Journal of Nanoparticle Research* 10.; 507-517.

Sharma V.K, Yngard R.A, Lin Y.2009 Silver nanoparticles: Green synthesis and antimicrobial activities. *Adv. Coll. Int. Sci*, , 145, 83-96.

Torresday, J.L.G., Parsons, J.G., Gomez, E., Videa, J.P., Troiani, H.E., Santiago, P. & Yacaman, M.J. 2002. Formation and growth of Au nanoparticles inside live alfa alfa plants. *Nanoletters* 2(4); 397- 401.

Udayasoorian, k, Vinothkumaar and R.m. Jaya Balakrishan., 2011, Novel route to synthesis of silver nanoparticles using medicinal plant (ocimum sanctum) leaf extracts foarnal of medicinal nand Aromaaaaaatiic *plant sclence* 33 (2) 128-132.

Wong C HB Li; KW Cheng; F Chen. 2006, *Food Chem* 97, 705.