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Biogenic Synthesis of Silver Nanoparticles and its Applications: Mini Review

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Abstract
In recent years, biological synthesis has emerged as an attractive alternative to traditional synthesis methods for producing nanoparticles. Biosynthesis involves using an environment-friendly green chemistry based approach. Plant extract acts as a reducing and capping agent in the synthesis of nanoparticles. This method does not produce toxic by-products and carried out at room temperature. The plant extract mediated nanoparticles provide simple, economical, green, rapid and safe method. This review article provides the recent trend in the biosynthesis of silver nanoparticles and its applications.
Keywords:- *Biosynthesis, Silver nanoparticles, Applications*

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I. Introduction:-

Extensive research and development in nanoscale science and technology has derived new pathways to basic and applied research in the sector of materials science and engineering, biotechnology, applied microbiology, quantum dots, and surface-enhanced Raman scattering[1–4].However, the nanotechnology find great importance in field of mechanics, optics, biomedical sciences, chemical industry, electronics, space industries, drug-gene delivery, energy science, catalysis, optoelectronic devices, and photo–electrochemical applications[5–8].The ability to tune the optical absorption/ emission properties of quantum dots (semiconductor nanoparticles) by simple variation in nanoparticle size is predominantly attractive in the facile band-gap engineering of materials[9],and the growth of quantum dot lasers[10]. Nanoparticles are of great interest due to their extremely small size and large surface to volume ratio, which lead to both chemical and physical differences in their properties compared to bulk of the same chemical composition[11,12]. Nanoparticles exhibit size and shape-dependent properties which are of interest for applications ranging from bio sensing and catalysts to optics, antimicrobial activity, computer transistors, electrometers, chemical sensors, and wireless electronic logic and memory schemes. These particles also have many applications in different fields such as medical imaging, nanocomposites, filters, drug delivery, and hyperthermia of tumours [13–15]. Gold nanoparticles have been engaged in immune assay, protein assay, cancer nanotechnology (especially detection of cancer cells),and capillary electrophoresis[16–19]. Silver nanoparticles show potential antimicrobial effects against infectious organisms such as *Escherichia coli*, *Bacillus subtilis*, *Vibria cholera*, *Pseudomonas aeruginosa*, *Syphillis typhus*, and *Staphylococcus aureus*[20].

Plant Mediated Synthesis of Metallic Nanoparticles

Bio fabrication of metallic nanoparticles by plants is currently under exploration. Biosynthesis ofmetallic nanoparticles especially precious metal (including gold and silver) nanoparticles using living plants (intra-cellular), plant extracts (extra-cellular) and phytochemicals has received significant consideration as an appropriate substitute to traditional physical and chemical procedures[21]. Plant-mediated synthesis of metallic nanoparticles has been shown to produce nanoparticles with shapes and sizes comparable with those produced through traditional physical and chemical methods[22]. The importance and benefits of plant-mediated synthesis of nanoparticles increases many fold due to the use of extracts from low-cost agricultural wastes are utilized for synthesis of metallic nanoparticles [23].In a view to attain more control over size and morphology of nanoparticles, researchers are now concentrating on the use of individual phytoconstituents (*e.g.*, polyphenols, proteins and organic acids) for the fabrication of metallic nanoparticles [24-25].Considering the importance and critical role of plants in biogenic protocols for fabrication of metallic nanoparticles, the green synthesis of metallic nanoparticles using various plant systems, probable mechanistic pathway, along with their commercial applications.

In recent years, biological synthesis has emerged as an attractive alternative to traditional synthesis methods for producing nanoparticles. Biosynthesis involves using an environment-friendly green chemistry

based approach that employs unicellular and multicellular biological entities such as actinomycetes [26-28], bacteria [29], fungus [30], plants [31], viruses [32], and yeast [33-34].Synthesizing nanoparticles via biological entities acting as biological factories offers a clean, nontoxic and environment-friendly method of synthesizing nanoparticles with a wide range of sizes, shapes, compositions, and physicochemical properties [35].

Recently, physiologically stable and bio-compatible silver nanoparticles have been synthesized by mixing the silver ion solution with leaf extract of *Azadirca indica* without using any surfactant or external energy [36]. Moreover, silver nanoparticles were synthesized using hot water *olive* leaf extracts as both reducing and stabilizing agent, and evaluated for antibacterial activity against drug-resistant bacteria isolates [37]. Another, aqueous extract of *Lakshmi tulasi* (*Ocimum sanctum*) leaf as a reducing and stabilizing agent for synthesis of silver nanopaerticles has been reported [38]. The synthesis and characterization of silver nanoparticles using *Iresineherbstii*and evaluation of their antibacterial, antioxidant, and cytotoxic activity have been reported [39]. The biological method for the synthesis of silver nanoparticles using *Annona squamosa* leaf extract and its cytotoxicity against MCF-7 cells has been reported [40]. silver nanoparticles with an average size of 26 nm have been also synthesized by exposing aqueous silver ions to *Coriandrumsativum* leaf extract as reducing agent [41]. Garole et al report biosynthesis silver nanoparticles using ficus racemosa latex [42].

Applications

Antimicrobial activity of biosynthesized SNPs was assessed by agar well diffusion method against bacterial strain such as Escherichia coli, Pseudomonas aeruginosa, Bacillus subtilis and Staphylococcus aureus [42] Diana Garino et al reported antimicrobial activity effect employing green synthesized AgNPs with *L. acapulcensis*.[43]. The synthesized AgNPs were screened for antibacterial and anti-biofilm activity against human pathogens *Pseudomonas aeruginosa*, *Escherichia coli*, and *Staphylococcus aureus*. Study demonstrate the potential of phyto-synthesized AgNPs to act as anti-biofilm agents and for other biomedical applications.[44]. AgNPs of size 25–30 nm synthesized using aqueous leaf extract of *Nerium oleander* showed highest mortality against both larvae and pupae of *Anopheles stephensi* [45] The incorporation of *Azadirachta indica* synthesized silver nanoparticles into cotton cloth results in antibacterial effect against *E. coli* [46].

II. Conclusion

In this review describe the plant extract mediated biosynthesis of silver nanoparticles. The synthesis nanoparticles using various plants are presented a database that could benefit researches on their future work regarding biogenic synthesis of silver nanoparticles. Wide variety of plants traditionally used for nanoparticles synthesis and its various applications.

References

[1]. H. Klefenz, Nanobiotechnology: From molecules to systems, Eng. Life Sci. 4 (2004) 211–218.
[2]. D.S. Goodsell, Bionanotechnology : lessons from nature, Wiley-Liss, 2004.
[3]. W.C.W. Chan, S. Nie, Quantum dot bioconjugates for ultrasensitive nonisotopic detection, Science 281 (1998) 2016–2018.
[4]. Z.-Q. Tian, B. Ren, Adsorption and Reaction At Electrochemical Interfaces As Probed By Surface-Enhanced Raman Spectroscopy, Annu. Rev. Phys. Chem. 55 (2004) 197–229.
[5]. A.J. Hoffman, G. Mills, H. Yee, M.R. Hoffmann, Q-sized cadmium sulfide: synthesis, characterization, and efficiency of photoinitiation of polymerization of several vinylic monomers, J. Phys. Chem. 96 (1992) 5546–5552.
[6]. Y. Wang, N. Herron, Nanometer-sized semiconductor clusters: Materials synthesis, quantum size effects, and photophysical properties, J. Phys. Chem. 95 (1991) 525–532.
[7]. H. Mansur, F. Grieser, M. Marychurch, S. Biggs, R. Urquhart, D. Furlong, Photoelectrochemical properties of Q-state CdS particles in arachidic acid LB films., J Chem Soc Farad Trans. 91 (1995) 665–672.
[8]. A.D. Yoffe, Low-dimensional systems: quantum size effects and electronic properties of semiconductor microcrystallites (zero-dimensional systems) and some quasi-two-dimensional systems, Adv. Phys. 42 (1993) 173–262.
[9]. J.H. Fendler, F.C. Meldrum, The Colloid Chemical Approach to Nanostructured Materials, Adv. Mater. 7 (1995) 607–632.
[10]. N.N. Ledentsov, N. Kirstaedter, M. Grundmann, D. Bimberg, I. V Kochnev, P.S. Kop, Z. Alferov, Three-dimensional arrays of self-ordered quantum dots for laser applications, Microelectronics J. 28 (1997) 915–931.
[11]. K. Bogunia-Kubik, M. Sugisaka, From molecular biology to nanotechnology and nanomedicine, BioSystems. 65 (2002) 123–138.
[12]. V.P. Zharov, J.W. Kim, D.T. Curiel, M. Everts, Self-assembling nanoclusters in living systems: application for integrated photothermal nanodiagnostics and nanotherapy, Nanomedicine Nanotechnology, Biol. Med. 1 (2005) 326–345.
[13]. M. Tan, G. Wang, Z. Ye, J. Yuan, Synthesis and characterization of titania-based monodisperse fluorescent europium nanoparticles for biolabeling, J. Lumin. 117 (2006) 20–28.
[14]. D. Pissuwan, S.M. Valenzuela, M.B. Cortie, Therapeutic possibilities of plasmonically heated gold nanoparticles, Trends Biotechnol. 24 (2006) 62–67.
[15]. S. Panigrahi, S. Kundu, S.K. Ghosh, S. Nath, T. Pal, General method of synthesis for metal nanoparticles, J. Nanoparticle Res. 6 (2004) 411–414.
[16]. X. Liu, Q. Dai, L. Austin, J. Coutts, G. Knowles, J. Zou, H. Chen, Q. Huo, A one-step homogeneous immunoassay for cancer biomarker detection using gold nanoparticle probes coupled with dynamic light scattering, J. Am. Chem. Soc. 130 (2008) 2780–2782.
[17]. D. Tang, R. Yuan, Y. Chai, Biochemical and immunochemical characterization of the antigen-antibody reaction on a non-toxic biomimetic interface immobilized red blood cells of crucian carp and gold nanoparticles, Biosens. Bioelectron. 22 (2007) 1116–1120.
[18]. C.D. Medley, J.E. Smith, Z. Tang, Y. Wu, S. Bamrungsap, W. Tan, Gold nanoparticle-based colorimetric assay for the direct

detection of cancerous cells, Anal. Chem. 80 (2008) 1067–1072.
[19]. W.L. Tseng, M.F. Huang, Y.F. Huang, H.T. Chang, Nanoparticle-filled capillary electrophoresis for the separation of long DNA molecules in the presence of hydrodynamic and electrokinetic forces, Electrophoresis. 26 (2005) 3069–3075.
[20]. N. Durán, P.D. Marcato, G.I.H. De Souza, O.L. Alves, E. Esposito, Antibacterial effect of silver nanoparticles produced by fungal process on textile fabrics and their effluent treatment, J. Biomed. Nanotechnol. 3 (2007) 203–208.
[21]. V. V. Makarov, A.J. Love, O. V. Sinitsyna, S.S. Makarova, I. V. Yaminsky, M.E. Taliansky, N.O. Kalinina, "Green" nanotechnologies: Synthesis of metal nanoparticles using plants, Acta Naturae. 6 (2014) 35–44.
[22]. J.G. Parsons, J.R. Peralta-Videa, J.L. Gardea-Torresdey, Chapter 21 Use of plants in biotechnology: Synthesis of metal nanoparticles by inactivated plant tissues, plant extracts, and living plants, Dev. Environ. Sci. 5 (2007) 463–485.
[23]. P.P. Gan, S.F.Y. Li, Potential of plant as a biological factory to synthesize gold and silver nanoparticles and their applications, Rev. Environ. Sci. Biotechnol. 11 (2012) 169–206.
[24]. S. Khaleel Basha, K. Govindaraju, R. Manikandan, J.S. Ahn, E.Y. Bae, G. Singaravelu, Phytochemical mediated gold nanoparticles and their PTP 1B inhibitory activity, Colloids Surfaces B Biointerfaces. 75 (2010) 405–409.
[25]. C. Tamuly, M. Hazarika, M. Bordoloi, P.K. Bhattacharyya, R. Kar, Biosynthesis of Ag nanoparticles using pedicellamide and its photocatalytic activity: An eco-friendly approach, Spectrochim. Acta - Part A Mol. Biomol. Spectrosc. 132 (2014) 687–691.
[26]. B. Buszewski, V. Railean-Plugaru, P. Pomastowski, K. Rafinska, M. Szultka-Mlynska, T. Kowalkowski, Antimicrobial Effectiveness of Bioactive Silver Nanoparticles Synthesized by Actinomycetes HGG16n Strain, Curr. Pharm. Biotechnol. 18 (2017) 168–176.
[27]. M.S.-V. Nélly, E.D.C. Nelson, de A.S. Taciana, V.Q. Patrick, R. de A. Alyne, C.M. de M. Ana, L. dos S.C. Ana, P.F.L. João, B.A. Ricardo, A. da S. Durcilene, R. de S. de A.L. José, F.S.T. Maria, Extracellular biogenic synthesis of silver nanoparticles by Actinomycetes from amazonic biome and its antimicrobial efficiency, African J. Biotechnol. 16 (2017) 2072–2082.
[28]. V.R. Ranjitha, V.R. Rai, Actinomycetes mediated synthesis of gold nanoparticles from the culture supernatant of Streptomyces griseoruber with special reference to catalytic activity, 3 Biotech. 7 (2017) 299.
[29]. H. Rostami, F. Khosravi, M. Mohseni, A.A. Rostami, Biosynthesis of Ag nanoparticles using isolated bacteria from contaminated sites and its application as an efficient catalyst for hydrazine electrooxidation, Int. J. Biol. Macromol. 107 (2018) 343–348.
[30]. S. Shende, A. Gade, M. Rai, Large-scale synthesis and antibacterial activity of fungal-derived silver nanoparticles, Environ. Chem. Lett. 15 (2017) 427–434.
[31]. P. Vishnukumar, S. Vivekanandhan, S. Muthuramkumar, Plant-Mediated Biogenic Synthesis of Palladium Nanoparticles: Recent Trends and Emerging Opportunities, ChemBioEng Rev. 4 (2017) 18–36.
[32]. S.W. Lee, C. Mao, C.E. Flynn, A.M. Belcher, Ordering of quantum dots, using genetically engineered viruses, Science (80-.). 296 (2002) 892–895.
[33]. C.T. Dameron, R.N. Reeses, R.K. Mehra, A.R. Kortan, P.J. Carrol, M.L. Steigerwald, L.E. Brus, D.R. Winge, Biosynthesis of cadmium sulphide quantum semiconductor crystallites, Nature. 338 (1989) 596–597.
[34]. M. Gericke, A. Pinches, Biological synthesis of metal nanoparticles, Adv. Colloid Interface Scoence. 156 (2010) 1–13.
[35]. S.. Mohanpuria, P.R., K.N. & Yadav, Biosynthesis of nanoparticles:technological concepts and future applications., J. Nanoparticle Res. 10 (2008) 507–517.
[36]. G.M. Nazeruddin, N.R. Prasad, S.R. Waghmare, K.M. Garadkar, I.S. Mulla, Extracellular biosynthesis of silver nanoparticle using Azadirachta indica leaf extract and its anti-microbial activity, J. Alloys Compd. 583 (2014) 272–277.
[37]. M.M.H. Khalil, E.H. Ismail, K.Z. El-Baghdady, D. Mohamed, Green synthesis of silver nanoparticles using olive leaf extract and its antibacterial activity, Arab. J. Chem. 7 (2014) 1131–1139.
[38]. Y. Subba Rao, V.S. Kotakadi, T.N.V.K.V. Prasad, A. V. Reddy, D.V.R. Sai Gopal, Green synthesis and spectral characterization of silver nanoparticles from Lakshmi tulasi (Ocimum sanctum) leaf extract, Spectrochim. Acta - Part A Mol. Biomol. Spectrosc. 103 (2013) 156–159.
[39]. C. Dipankar, S. Murugan, The green synthesis, characterization and evaluation of the biological activities of silver nanoparticles synthesized from Iresine herbstii leaf aqueous extracts, Colloids Surfaces B Biointerfaces. 98 (2012) 112–119.
[40]. R. Vivek, R. Thangam, K. Muthuchelian, P. Gunasekaran, K. Kaveri, S. Kannan, Green biosynthesis of silver nanoparticles from Annona squamosa leaf extract and its in vitro cytotoxic effect on MCF-7 cells, Process Biochem. 47 (2012) 2405–2410.
[41]. R. Sathyavathi, M.B. Krishna, S.V. Rao, R. Saritha, D.N. Rao, Biosynthesis of Silver Nanoparticles Using <I>Coriandrum Sativum</I> Leaf Extract and Their Application in Nonlinear Optics, Adv. Sci. Lett. 3 (2010) 138–143.
[42]. V. J Garole, D. J. Garole, S. R. Tetgure, B. C. Choudhary & A. U. Borse, Bosynthesis of Silver Nanoparticles Using Ficus racemosa Latex and Its Antimicrobial Activity,WJPR, 7,4, 1(2018) 1385-1400.
[43]. Diana Garibo, Hugo A. Borbón-Nuñez, Jorge N. Díaz de León, Ernesto García Mendoza, Iván Estrada, Yanis Toledano-Magaña, Hugo Tiznado,Marcela Ovalle-Marroquin, Alicia G. Soto-Ramos, Alberto Blanco,José A. Rodríguez, Oscar A. Romo, Luis A. Chávez-lmazán & Arturo Susarrey-Arce , Green synthesis of silver nanoparticles using *Lysiloma acapulcensis* exhibit high-antimicrobial activity, *Sci Rep* 10, (2020),12805.
[44]. Mohanta Y. K, Biswas K, Jena S. K, Hashem A, Abd Allah E. F and Mohanta T.K , Anti-biofilm and Antibacterial Activities of Silver Nanoparticles Synthesized by the Reducing Activity of Phytoconstituents Present in the Indian Medicinal Plants. *Front. Microbiol.* 11, (2020)1143.
[45]. M. Roni, K. Murugan, C. Panneerselvam, J. Subramaniam, and J.-S. Hwang, "Evaluation of leaf aqueous extract and synthesized silver nanoparticles using *Nerium oleander* against *Anopheles stephensi* (Diptera: Culicidae)," *Parasitology Research*, vol. 112, 3,(2013) 981–990.
[46]. Tripathi, N. Chandrasekaran, A. M. Raichur, and A. Mukherjee, "Antibacterial applications of silver nanoparticles synthesized by aqueous extract of *Azadirachta Indica* (Neem) leaves," *Journal of Biomedical Nanotechnology*, vol. 5, no. 1, pp. 93–98, 2009.

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