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A REVIEW ON THE BIOSYNTHESIS OF GOLD METAL NANOPARTICLES BY MICROBES

Jaydeep V. Deore[1] & Harshad R. Sonawane[2]

Department of Chemistry, G. M. Vedak College of Science, Tala-Raigad (M.S.)

Abstract

Gold nanoparticles has gotten exceptional likely inferable from their various applications in bioimaging, biolabels, biosensors, biomedicine, etc. A number of chemical and physical methods for the synthesis of gold nanoparticles have been reported in the literature among which the biological synthesis of gold nanoparticles as an emerging highlight has attracted more and attention due to its advantages of cost-effective and environmentally friendly nature. The utilization of microorganism in the blend of gold nanoparticles arises as an eco-accommodating and energizing methodology. In this review, a comprehensive study was conducted on synthesis, characterization, and various applications of gold NPs produced using various microbes

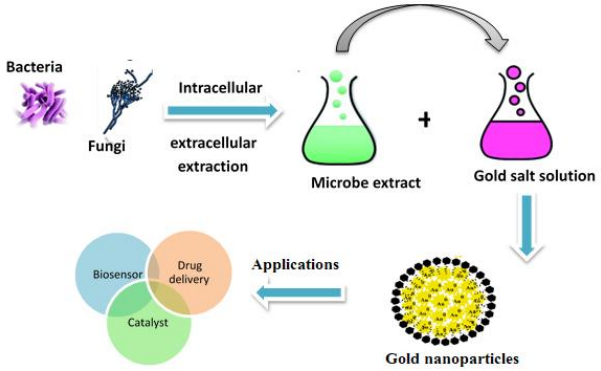


Fig.1 Method for the synthesis of nanoparticles

Keywords: *Green synthesis, Fungi, Bacteria, Gold nanoparticles, Eco-friendly,*

Introduction:

Nanotechnology is a new and emerging technology with tremendous of applications. It involves the synthesis and application of materials having one or more than two dimensions in the range of 1–100 nm. Metal nanoparticles have been gaining importance in the past

decade because of their unique properties. Amongst the noble metal (Ag, Au and Pt) gold nanoparticles are increasing interest due to their application in the field of catalysis, bio-imaging, biosensors, and drug delivery, treatment of cancer cell and so forth (1-8). In recent years a wide variety of physico–chemical approaches are being used for the synthesis of gold nanoparticles (9). Although chemical attempts are the most popular methods for the production of nanoparticles, however these synthetic protocols are hazardous, unsafe and adsorption of toxic chemicals on the surface of nanomaterials making them unsuitable for biomedical applications. Hence there is a growing need to develop environmentally benign nanoparticle synthesis processes that do not use toxic chemicals in the synthesis protocol. The use of microorganism in the synthesis of gold nanoparticles emerges as an eco-friendly and exciting approach. According reports, nanoparticles synthesized using biological methods are more stable (10). Biogenic synthesis of nanoparticles involves from pant extraction and microbe synthesis. A number of microorganisms have been reported to have the capacity of reducing gold ions into gold nanoparticles including bacteria, fungi, yeast and actinomyces. The active molecules present in the microbial system can be used as reducing and stabilizing agents for the biogenic synthesis, thus, there is no need of other chemical reagent. Among the microbe's fungi are considered as superior microbial resources for the green synthesis of gold nanoparticles. Early studies have revealed that microbes are able to reduce Au^{+3} ions to produce octahedral gold particles of nanoscale dimensions (5-25 nm) within bacterial cells by incubation of the cells with gold chloride **(11-13).** This review mainly focuses on the synthesis of Au NPs using microbes, with an emphasis on their applications.

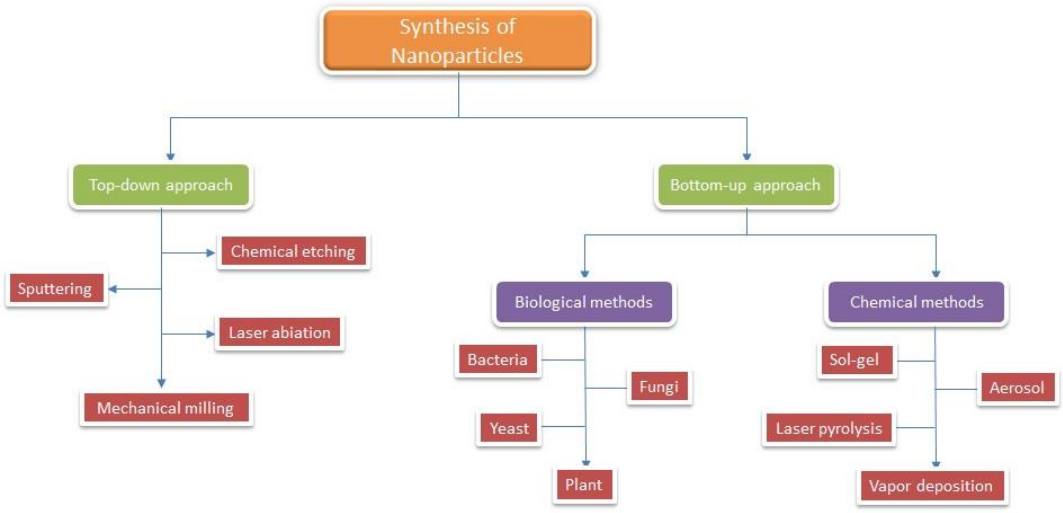
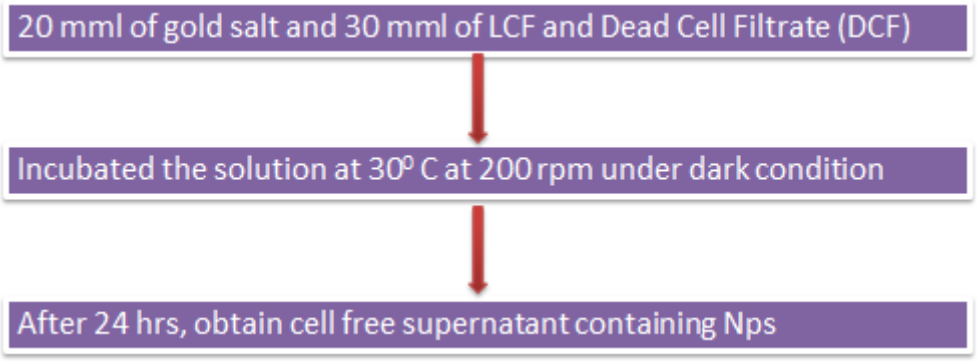


Fig. 2 different method for synthesis of nanoparticles

Biosynthesis of gold NPs using fungus:

Gold nanoparticles were synthesised by using the fungus *Penicillium brevicompactum* extracellularly and got a positive result with living cell filtrate (LCF) and supernant broth of fungus. At 30^0 C gold nanoparticles (20 to 80 nm) were synthesised and showed cytotoxicity effects against mouse mayo blast cancer C_2C_{12} cells (14).



The one step biosynthesis method provides a rapid route for the controlled synthesis of gold nanoparticles using *Aspergillus terreus IF0* and its antibacterial property against a gram-negative pathogenic bacterium (15). Fungus *Hormoconis resinae* was used to synthesis gold nanoparticles extracellularly. The fungus was isolated on culture medium from soil near a refinery (16).

Biosynthesis of gold NPs using bacteria

Biogenic synthesis of gold nanoparticles using bacteria *Pseudomonas fluorescens* is reliable and with eco-friendly protocol were reported (16). Pseudomonas fluorescens was isolated and cultured. It was grown up in a conical flask containing 100 ml of nutrient broth in a shaker incubator at 37^0 C. after 24-48 hrs of incubation, biomass developed on the medium. Aqueous Auric Chloride was added into the culture medium. Then reaction mixture was kept for 24 hrs in shaker at 37^0 C. Biotransformation occurred chloroaurate ions were reduced to gold nanoparticles. A culture of freshly prepared K. *Pneumoniae* was inoculated in 250 ml conical flask containing 100 ml clean supplement stock. Then it was incubated at 37^0 C for 24 hrs in a shaker at 120 rpm. After overnight Culture was centrifuged at 6000 rpm for 10 minutes and the supernatant was used for synthesis of gold nanoparticles. To this solution, 1mM gold chloride was added and the solution was incubated at 37^0 C for 24 hrs. (17)

Challenges

Despite the way that the potential gains of microorganisms in biogenic synthesis of gold nanoparticles there are yet numerous challenges. Under a given set of biosynthetic conditions control of size, shape and crystallinity of metal nanoparticles in which the genuine

biosynthesis measure haven't easy. The various characteristics of microorganisms make particular filtration and affirmation of various compounds is a difficult task. The strength of nanoparticle is another issue to consider. It is a fundamental piece of the nanoparticles when they are blended to shape a stable in the midst of capacity and have no vital changes of the morphology before they are used as a piece of convenient applications. Besides hurtfulness (harmfulness) appraisal and moreover regular impact of these metal nanoparticles are also fundamental points to be thought of. The important metals having a monetary centrality in human use are in like manner suitable in nature [18]

Scope and Applications

Biosynthesis of metallic nanoparticles has gotten a lot of consideration due to the benefits of this strategy. Synthesis of nanoparticles by using a biological method is environmentally friendly. The naturally available sources such as bacteria or fungi can be used as reducing agent [19]. Biosynthesis of nanoparticles doesn't required high pressure, temperature, toxic chemicals, energy etc. Actually the size and shape of extracellularly synthesized nanoparticles by using microbe can be control by adjusting the pH, concentration, reaction time and temperature. Nanoparticles are adaptable materials with a sweeping extent of scope in a variety of fields. Scientist has covered gold nanoparticles with nucleic acid (DNA). It will ensure that some genetic material will enter the cell and change them. The optical devices properties of gold nanoparticles are being examined comprehensively for use in high development applications electronic conductors, tactile tests, characteristic photovoltaic, drug conveyance in natural and remedial applications, and catalysis. Gold nanoparticles are widely used in biomedicine in light of their properties, for example, simplicity of discovery, high functionality, and low harmfulness (20). In addition, the management of gold nanoparticles in human is protected on account of their low cytotoxicity [21]. Gold nanoparticles are used for different applications as a result of their high dependability and remarkable electronic, optical, and spectroscopic properties (22)

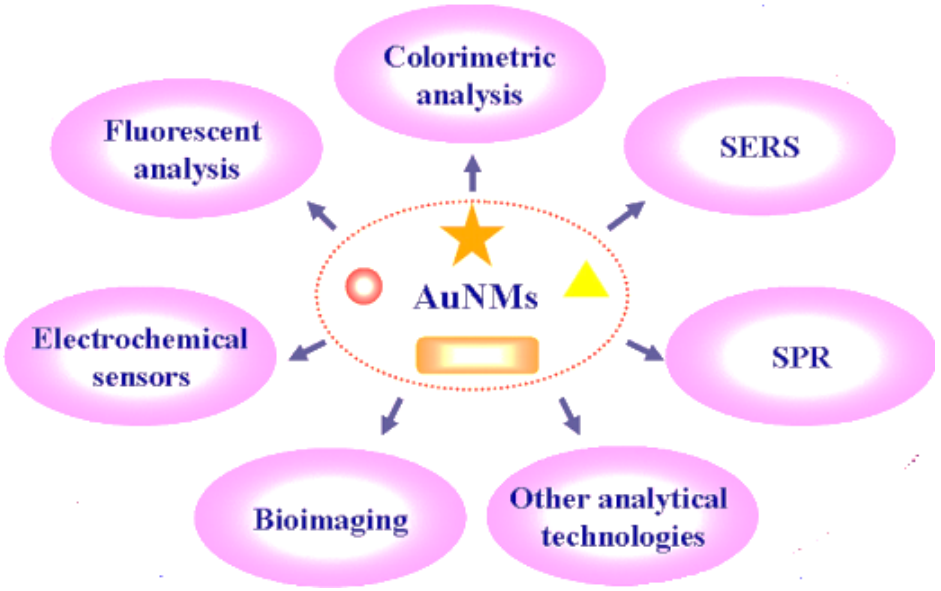


Fig. 3 application of gold nanoparticles

Reference:

Pal R, Panigrahi S, Bhattacharyya D, Chakraborti AS. 2013 J. Mol Struct. 1046:153–163.

Daniel MC, Astruc D. 2004 Chem Rev. 104:293–346

He Y, Yuan J, Su F, Xing X, Shi G. J Phys Chem 2006; 110(36): 17813-17818.

Han, M., Gao, X., Su, J.Z., & Nie, S. (2001)Nature Biotechnolnology 19, 631–635.

Huang, X., El-Sayed, I., Qian,W., & El-Sayed, M.A. (2006) Journal of the American Chemical Society, 128, 2115–2120.

Mirkin, C.A., Letsinger, R.L., Mucic, R.C., & Storhoff, J.J. (1996). Nature, 382, 607–609.

Salem, A.K., Searson, P.C., & Leong, K.W. (2003)Nature Materials, 2, 668–671

M. Murugan, K. John, P. Anthony, M. Jeyaraj, N. Krishnaraj, S. Gurunathan, J. Ind. Eng. Chem. (2013)

Wang Y., Xia Y. Nanoletters. 2004;4:2047–2050

Sharma, D.; Kanchi, S.; Bisetty, K. A Review. Arabian J. Chem. 2015.

G. Southam and T.J. Beveridge, Geochim. Cosmochim. Acta, 58 (1994), pp. 4527–4530.

D. Fortin and T.J. Beveridge, in Biomineralisation, ed. E. Baeuerlein (Verlag, Germany: Wiley-VCH, 2000), p. 294.

T.J. Beveridge and R.G.E. Murray, J. Bacteriol., 141 (1980), pp. 876–877.

Amirta M., Suraj k., Rizwan W., App Microbiol Biotrchnol (2011) 92, 617-630

Eepista P., Nilotpala P., Lala B S, and Prasana k P.,Journal of Nanotechnology Volume 2014, Article ID 653198, 9 pages

Anuj N M.,Seema B., Mulayam S Gand Renu p.,JOM Vol 62 no.11 November 2010

Radhika R. SR, Suman TY, Asian Pacific Journal of Tropical Disease (2012) S795-S799

Cruickshan R, Duguid JP, Marmion BP, Swain RHA. the Practice of Medical Microbiology 2: 170–189, 1975.

M. Sastry, A. Ahmad, M. I. Khan, and R. Kumar, Nanotechnology, pp. 126–135, 2005.

P. M. Tiwari, K. Vig, V. A. Dennis, and S. R. Singh, Nanomaterials, vol. 1, no. 1, pp. 31–63, 2011.

E. E. Connor, J. Mwamuka, A. Gole, C. J. Murphy, and M. D. Wyatt, vol. 1, no. 3, pp. 325–327, 2005.

P. N. Njoki, I. I. S. Lim, D. Mott et al. Journal of Physical Chemistry C, vol. 111, no. 40, pp. 14664–14669, 2007.