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SYNTHESIS OF GOLD AND SILVER NANO PARTICLES BY PROKARYOTES AND EUKARYOTES A COMPARATIVE STUDY

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ABSTRACT

Silver and gold nano particles are synthesized by prokaryotes as well as eukaryotes. Biosynthetic approach using bacteria and fungus is a novel way towards the development of safe, economically viable and green method for the synthesis of silver and gold nanoparticles and thus synthesized silver and gold nanoparticles can be used in antibacterial formulations. We report the extracellular synthesis of silver and gold nanoparticles using bacteria like pseudomonas and bacillus specie sand fungus like *sp.F.solani, Oxysporiu Penicillium, C.lunata, Lindenthianum, Monoliformi*,. Detection of synthesized silver and gold nanoparticles was carried out using UV-Visible spectrophotometer analysis, which showed a peak ranging between 420-450 nm indicating the formation of nanoparticles. The method of synthesize of nano particles are ecofreindly easy to synthesized, without any risk and economically viable. In this review article we are comparing the synthesized pattern and way of synthesis of silver and gold nano particles by prokaryotes and eukaryotes differently.

KEYWORDS: Fungus, Silver Nanoparticles, gold nano particles, Economically viable.

INTRODUCTION

Nanotechnology is emerging field of science which involves synthesis and development of various nonmaterial's. At present, different types of metal nonmaterial's are being produced using copper, zinc, titanium, magnesium, gold, alginate and silver. These nonmaterial's are used in various fields such as optical devices, catalytic, bactericidal, electronic, sensor technology, biological labelling and treatment of some cancers. In last decay, application of nano material has been extensively increase and the high demands leads to the bulk production of the nonmaterial. Classically the nanoparticles are produced by physical and chemical methods, as these methods are costly, toxic and non eco friendly scientists are looking forward to synthesize low cost, non toxic, eco friendly nanoparticles. Most recently, biosynthesis of nanoparticles using bacteria, fungus and plants have emerged as a simple and viable alternative to more complex physical and chemical synthetic procedures to Obtain nonmaterial's. Metal nanoparticles are undoubtedly the most widely used nanomaterials among all. Metal nanoparticles are used in antimicrobial agents, textile industries, water treatment, sunscreen lotions etc. The fungi possess some advantages over bacteria in nanoparticles synthesis, as most of the fungi are easy to handle, required simple nutrient, possess high wall-binding capacity, as well as intracellular metal uptake capabilities. This study involves the biological synthesis of metal nanoparticles using filamentous fungus.

Metal nanoparticles have promising applications in the fields of medicine, electronics, agriculture, etc. In the present scenario pharmaceutical and biomedical sector are facing the challenge of continuous increase in the emerging pathogens, with their antibiotic resistance profiles, with fear about the emergence and re-emergence of multi-drug resistant pathogens and parasites. Therefore, in this modern era the priority areas of research are concerning the development or modification in antimicrobial compounds in order to improve bactericidal potential. Nanotechnology is the engineering and technological applications of the nano-materials and nanoparticles of size ranging from (1-100 nm). Nanotechnology provide platform to modify and develop the important properties of metal in the form of nanoparticles having promising applications in diagnostics, biomarkers, cell labelling, contrast agents for biological imaging, antimicrobial agents, drug delivery systems and nano-drugs for treatment of various diseases. Biosynthesis of nanoparticles is accomplished using microorganism which grabs target ions from their solutions, and then accumulates the reduced metal in its element form through enzymes generated by microbial cell activities. It can be categorized into intracellular and extracellular synthesis according to the place where nanoparticles are formed (Simkiss and Wilbur, 1989; Mann, 1996). The intracellular method consists of transporting ions into the microbial cell to form the nanoparticles in the presence of enzymes. The extracellular synthesis of nanoparticles involves trapping the metal ions on the surface of the cells and reducing ions in the presence of enzymes. So far, many microbes, such as magnetotactic bacteria (Blackmore, 1982), diatoms (Mann, 2001), S-layer bacteria (Pum and Sleytr, 1999), fungi (Bruins et al., 2000), actinomycete (Ahmad et al., 2003c) and yeast (Mithila et al., 2009) have been employed for generating nanostructured mineral crystals and metallic nanoparticles and the control of the size, shape, composition and monodispersity of particles were also studied. On the other hand, nanoparticle effect on microbes has also caught a great attention. Nanoparticles are capable of assisting microbe activities. Several studies have been reported on nanoparticle influence on the microbiological reaction rates (De Windt et al., 2005; Shin and Cha, 2008). Adding catalysts in the reaction is the common method to change the reaction rates (Huang et al., 2005; Anna et al., 2007).

Many fungi like Fusariumacuminatum, F.solani, Aspergillusniger, Phomaglomerata, Alternariaalternae, F. culmorum etc. have been successfully used for the synthesis of silver nanoparticles. These studies confirmed that among the different biological agents, fungi are more efficient candidates for fabrication of metal nanoparticles both intra- and extracellulary. Extracellular biosynthesis of silver nanoparticles using fungi has advantages like more simple and eco-friendly approach as compared to chemical and physical methods, The antimicrobial potential of silver nanoparticles have been examined and found to be effective against many pathogens. It is demonstrated antibacterial activity of silver nanoparticles synthesized from *F. acuminatum* against human pathogenic bacteria like S. typhi, E. coli, S. epidermidisand multi-drug resistant *S. aureus*, Similarly, Gade and colleagues, reported antibacterial activity of silver nanoparticles against Gram-positive *(S. aureus)* and Gram-negative (E. coli) bacteria. Besides antimicrobial agents, silver nanoparticles are used in bio-labeling biosensors and filters, nanodressings and textile fabrics beneficial for the burnt patients, for surgical masks,[19] in tissue conditioner.[20], etc. Thus, silver nanoparticles are the ideal candidate for the development of novel antimicrobial product and these are said to be antimicrobials of new generations.

In the present study, we have used *Fusarium sp. solani* for the extracellular synthesis of silver nanoparticles. We also evaluated their antibacterial activity. The main reason behind the use of fungus was that, it is non pathogenic in nature and therefore, easy to handle and culture.

Scope of study: Silver nano particles are the particles having one or more dimensions of order of 100nm or less. In nanotechnology, a particle is described as whole unit in terms of transport and properties. In terms of diameter, fine particels cover a range between 1 to 100 nm.

Nanoparticles research is currently an area of intense scientific research due to a wide variety of potential applications in biomedical, optical and electronics, etc. They form an effective bridge between bulk material and atomic molecular structures. Suspensions of nanoparticles are possible because the interaction of the particle surface with the solvent is strong enough to overcome differences in density which usually result in a material either sinking or floating in a liquid.

Applications: The unique size dependent properties make them very attractive for pharmaceutical operations. Cytotoxic effects of certain engineered nanoparticles towards malignant cells forms basis for nano-medicine. Three dimensional shape, hydrophobicity, electronic configuration make nanoparticles an appealing subject in medicinal chemistry.

Eukaryotic: Eukaryotic nitrate reductases are part of the sulfite oxidase family of molybdo enzymes. They transfer electrons from NADH or NADPH to nitrate.

Prokaryotic: Prokaryotic nitrate reductases belong to the DMSO reductase family of molybdoenzymes and have been classified into three groups, assimilatory nitrate reductases (Nas), respiratory nitrate reductase (Nar), and periplasmic nitrate reductases (Nap). The active site of these enzymes is a Mo ion that is bound to the four thiolate functions of two pterin molecules. The coordination sphere of the Mo is completed by one amino-acid side chain and oxygen and/or sulfur ligands. The exact environment of the Mo ion in certain of these enzymes (oxygen versus sulfur as a sixth molybdenum ligand) is still debated. The Mo is covalently attached to the protein by a cysteine ligand in Nap and an aspartate in Nar.

Structure: The transmembrane respiratory nitrate reductase (EC) is composed of three subunits; an alpha, a beta and two gamma. It is the second nitrate reductase enzyme which it can substitute for the NRA enzyme in Escherichia coli allowing it to use nitrate as an electron acceptor during anaerobic respiration. Nitratereductase gamma subunit resembles cytochrome b and transfers electrons from quinones to the beta subunit. The nitrate reductase of higher plants is a cytosolic protein. There exists a GPI-anchored variant that is found on the outer face of the plasma membrane. Its exact function is still not clear. Atransmembrane nitrate reductase that can function as a proton pump (similar to the case of anaerobic respiration) has been discovered in a diatom Thalassiosiraweissflogii.

Action: It has already been established that Neurospora nitrate reductase, which catalyzes the reduction of nitrate to nitrite by TPNH,' is a metalloflavo- protein with FAD as the prosthetic group and molybdenum as the metal component (l-3). This paper elaborates a preliminary report in which it was shown that, during the enzymatic transfer of electrons from TPNH to nitrate, both FAD (or

FMN) and molybdenum function as electron carriers. Evidence is also presented to show that the reduction sequence mediated by nitrate reductase from Neurospora is as follows: TPNH --) FAD (or FMN) -+ MO + NOs-

MATERIALS AND METHODS

Fungi used

C. lunata: Curvularia is a hyphomycete (mold) fungus which is a facultative pathogen of many plant species and of the soil. Most Curvularia are found in tropical regions, though a few are found in temperate zones.

Curvularia defined by the type species C. lunata (Wakker) Boedijn. Curvularialunata appears as shiny velvety-black, fluffy growth on the colony surface. C. lunata is distinguished by septate, dematiaceous hyphae producing brown, geniculate conidiophores.

Monoliformis: Moniliformis is a genus of parasitic worm, from the family Moniliformidae. Although unusual, human infection by Moniliformismoniliformis has been observed in the United States and Iran. Infection is known as acanthocephaliasis.

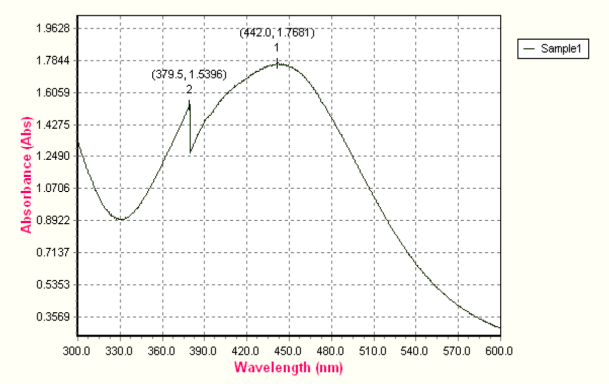
F. solani: Fusariumsolani is a filamentous fungus in the genus Fusarium and the anamorph of Haematonectriahaematococca. Commonly isolated from soil and plant debris. The fungus has a worldwide distribution, but its frequency as a medically important pathogen is not fully known. Aside from keratitis, it is an infrequent cause of fungal infections but remains the most common disease-causing fungus in its genus.

Oxysporium: The ascomycete fungus Fusariumoxysporum Schlecht. asemended by Snyder and Hansen comprises all the species, varieties and forms recognized by Wollenweber and Reinking within an infrageneric grouping called section Elegans. While the species, as defined by Snyder and Hansen, has been widely accepted for more than 50 years, more recent work indicates this taxon is actually a genetically heterogeneous polytypic morphospecies whose strains represent some of the most abundant and widespread microbes of the global soil microflora, although this last statement has not been proven or supported by actual data. These remarkably diverse and adaptable fungi have been found in soils ranging from the Sonoran Desert, to tropical and temperate forests, grasslands and soils of the tundra F. oxysporum strains are ubiquitous soil inhabitants that have the ability to exist as saprophytes, and degrade lignin and complex carbohydrates associated with soil debris. They are also pervasive plant endophytes that can colonize plant roots and may even protect plants or be the basis of disease suppression.[16][17] Although the predominant role of these fungi in native soils may be as harmless or even beneficial plant endophytes or soil saprophytes, many strains within the F. oxysporum complex are pathogenic to plants, especially in agricultural settings.

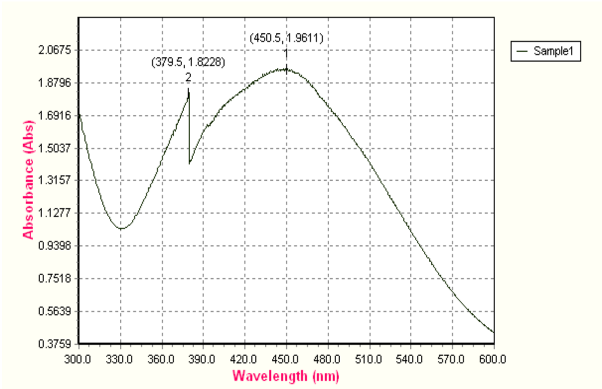
Isolation and identification of Different fungal species: The fungal culture was isolated from the soil by serial dilution technique. The isolated fungal culturewas purified by sub-culturing on Czapek-Dox agar mediumand was finally maintained on the same slants for identification. The identification of the fungal culture was done on the basis ofthe microscopic and macroscopic characteristics as followed by Narasimha et al.[20] by referring to the standard book entitled

RESULT AND DISCUSSION

Prokaryotes and eukaryotes synthesized gold and silver nano particles in same manner i.e. by reductase enzyme, the result obtained of silver nano particles spectrophotometrically shows that nanoparticles synthesized by fungi shows maximum absorption at 450nm and that is of bacteria of about 444nm. The result obtained are near to standers values, detail work should be require to compare the study between prokaryotes and eukaryotes.



Spectral analysis of gold nano particles by fungi



Spectral analysis of gold nano particles by bacteria

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