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Short Communication

Synthesis of Nanoparticles using Silver & Gold and their uses with special emphasis on medicine

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ABSTRACT

Nanoparticles of noble metals synthesized by biological routes have many important applications. Applications of gold and silver nanoparticles. Nanoparticle will make use of molecular machine to attend to medical problems and molecular knowledge is used to maintain and improve human health at the molecular scale. It will lead to preservation and improvement of human health.

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Particles measuring approximately in the range 1 to 100 nm are called as nanoparticles. They can be obtained in a variety of sizes and shapes like cylindrical, rhombic or circular by controlling conditions of synthesis process. Historically, the synthesis of nanoparticles started by employing physical and chemical methods like reduction, solgel, ball milling, sputter deposition, laser ablation, self assembly like micelles and reverse micelles, lithography, ultrasonic technique, immobilization of particles in some matrix like glass, zeolites or polymer micelles and electrochemical techniques. However synthesis of nanoparticles using biological systems like microorganisms and plant extracts is novel approach. It is also cheap and ecofriendly. Physicochemical methods use toxic reactants and comparatively costly. The only disadvantage of biosynthesis is that it is very time taking; it may require seven days to form nanoparticles. Bacteria and fungi have been used for the synthesis of metal nanoparticles. Using plant extract is cheaper than microorganisms as it does not require culture preparation or maintenance of aseptic conditions. Nanoparticles find immense applications in Agriculture, Environment, Medicine, Biotechnology and Industry. They have been used in biosensors, biomedical devices, drug delivery systems, electronics, optics, optoelectronics, storage devices, reprography, solar batteries, photoelectrochemical devices, semiconductor devices, catalysis and to generate supermagnetism and superchilling conditions. Metal nanoparticles (selenium, tellurium, uranium, zirconium, zinc, palladium, silver, gold, copper, iron and nickel) have been extensively synthesized and studied because of their unique physicochemical properties and large number of applications. Nanoscale biosynthesis of two noble metals silver and gold is of particular interest and importance. Biosynthesis process and characterization: In order to biosynthesize noble metal nanoparticles of particular shape, size and properties, specific methodologies have been formulated. Biosynthesis processes of nanoparticles of gold, silver and their alloy by bacteria, actinomycetes, fungi and yeasts have been developed. Before actual synthesis, the growth conditions of producing culture are physicochemically optimized. Knowledge regarding cellular, metabolic processes and genetics of the microbe if possible should be available. This information is useful for scaling up particular

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biosynthetic process. Isolated pure culture is inoculated in growth medium containing silver nitrate (AgNO3) solution. After defined incubation period silver nanoparticles are formed. Nanoparticles can be observed and studied under scanning or transmission electron microscope. Microscopic study reveals location (periplasmic or cytoplasmic or cell wall) and shape of synthesized nanoparticles. Nanoparticles can be characterized further employing sophisticated techniques of Physics such as Photoluminescence spectra, Xray diffraction or Atomic absorption spectroscopy. To increase the rate of reaction or to control size and monodispersity of nanoparticles formed; combinatorial approach can also be used. Approach can be heat treatment or cold storage or treating with microwave radiation or a genetic manipulation. Scientists have to try such troublesome efforts until nanoparticles of desired properties are obtained. The same methods are used in synthesis of gold nanoparticles except silver nitrate is replaced by aurium chloride (AuCl4). Bacteria like Pseudomonas, Klebsiella, Bacillus, Lactobacillus; fungi Verticillium, Fusarium, Actinomycete Thermomonospora; yeasts Torulopsis, Saccharomyces, Schizosaccharomyces have been used for synthesis of gold and silver nanoparticles. Both gold and silver nanoparticles have also been prepared using plant (leaf) extracts from clove, onion and Aloe vera. Compared to microbial culture, the reduction time required is of few minutes, so the formations of nanoparticles do not take hours or days. This biosynthesis is very advantageous for rapid synthesis of nanoparticles. Mechanism of biosynthesis: Microbes are since long times are known to produce extracellular or intracellular organic (metachromatic or PHB) and inorganic (magnetite, silicate or calcium carbonate crystals) compounds. By considering the microbial cell as a factory, we have modulated their metabolic activities at laboratory level for synthesis of nanomaterials. The principle of formation of nanoparticles is based on the microbial remediation of toxic chemicals in environment via reduction of metal ions. Some microbes produce extracellular enzymes with redox potential act as electron shuttle for metal reduction.

Applications of gold and silver nanoparticles:

Gold nanoparticles:
o In making transistors
o Photothermal agents
o As a catalyst to breakdown volatile organic compounds
o In therapeutics, for treatment of arthritis, Alzheimer's disease
o Efficient drug delivery systems
o For detection of cancerous tumors
o Immunostaining
o Biosensors

Silver nanoparticles:
o In manufacture of odor resistant fabrics
o Surgical instruments and dressings
o Catalysis o Optoelectronics and home appliances
o Antifungal and antibacterial agent
o Water treatment
o Power cells and batteries

MEDICAL USE OF NANOMATERIALS

Lately nanomedicines have been tested in mice and are also awaiting human trials. They use gold nanoshells to help diagnose and treat cancer, and using liposomes as vaccine adjuvant which in turn acts as vehicles for drug transport. Drug detoxification has shown promising results in rats. nanoscale are smaller devices which are less invasive and can also be implanted inside the body, provided biochemical reaction times are much shorter too. These devices are faster and more sensitive than typical drug delivery. Nanodevices could be observed at work inside the body using MRI, Medical nanodevices would first be injected into a human body, which then reaches to specific targeted area like tumor etc. Doctors can also monitor these and once they have reached to the right spot, doctors can go ahead with the procedure. Nanoparticles of cadmium selenide glow when open to the elements of ultraviolet light. These are called quantum dots . These are of different sizes. Different sizes are selected so that the frequency of light used to make a group of quantum dots fluoresce is manifold of the frequency required to make another group incandesce. Then both groups can be lit with a single light source. When are injected, they leek into cancer tumors. The surgeon can see the glowing tumor, and use it as a guide for more accurate tumor removal.

THE PARTICLES OF THE NANOMEDICINE ARE USEFUL IN:
• Drug delivery
• Protein and peptide delivery
• Nanoparticle targeting
• Neuroelectronic interfaces.

Nano scale Imaging has lead to the detection of certain of Protein Aggregates that leads Huntington's disease. Advances in nanotechnology are beginning to exert a significant impact in neurology which helps in dealing with Alzheimer's disease.