Journal of Pharmaceutical and Pharmacological Sciences

Review Article

Jaithliya T, J Pharma Pharma Sci 02: JPPS-127.
DOI:10.29011/2574-7711.100027

A Review on Nanotechnology: Nanopartcles

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Citation: Jaithliya T (2017) A Review on Nanotechnology: Nanopartcles. J Pharma Pharma Sci 02: 127. DOI: 10.29011/2574-7711.100027

Received Date: 15 March, 2017; **Accepted Date:** 28 March, 2017; **Published Date:** 5 April, 2017

Abstract

Nanotechnology refers to the creation and utilization of materials whose constituents exist at the nanoscale; and, by convention, be up to 100 nm in size. Nanotechnology explores electrical, optical, and magnetic activity as well as structural behavior at the molecular and submolecular level. It has the potential to revolutionize a series of medical and biotechnology tools and procedures so that they are portable, cheaper, safer, and easier to administer. Nanoparticles are being used for diverse purposes, from medical treatments, using in various branches of industry production such as solar and oxide fuel batteries for energy storage, to wide incorporation into diverse materials of everyday use such as cosmetics or clothes, optical devices, catalytic, bactericidal, electronic, sensor technology, biological labeling and treatment of some cancers. Due to their exceptional properties including antibacterial activity, high resistance to oxidation and high thermal conductivity, Nanoparticles have attracted considerable attention in recent years. Nanoparticles can be synthesized chemically or biologically. Metallic Nanoparticles that have immense applications in industries are of different types, namely, Gold, Silver, Alloy, magnetic etc. This study aims to present an overview of Nanoparticles, with special reference to their mechanism of biosynthesis and types.

Introduction

Nanotechnology refers to an emerging field of science that includes synthesis and development of various Nanomaterials. Nanoparticles can be defined as objects ranging in size from 1-100 nm that due to their size may differ from the bulk material. Presently, different metallic Nanomaterials are being produced using copper, zinc, titanium, magnesium, gold, alginate and silver. Nanoparticles are being used for diverse purposes, from medical treatments, using in various branches of industry production such as solar and oxide fuel batteries for energy storage, to wide incorporation into diverse materials of everyday use such as cosmetics or clothes [1].

Synthesis of Nanoparticles

Nanoparticles can be synthesized chemically or biologically. Many adverse effects have been associated with chemical synthesis methods due to the presence of some toxic chemical absorbed on the surface. Eco friendly alternatives to Chemical and physical methods are Biological ways of Nanoparticles synthesis using microorganisms [2,3], enzymes [4], fungus [5], and plants or plant extracts [6,7]. The development of these eco-friendly methods for the synthesis of Nanoparticles is evolving into an important branch of nanotechnology especially silver Nanoparticles, which have many applications [8-10].

Biosynthesis: Mechanism

Biosynthesis of Nanoparticles by microorganisms is a green and eco-friendly technology. Diverse microorganisms, both prokaryotes and eukaryotes are used for synthesis of metallic Nanoparticles viz. silver, gold, and platinum, zirconium, palladium, iron, cadmium and metal oxides such as titanium oxide, zinc oxide, etc. These microorganisms include bacteria, actionmycetes, fungi and algae. The synthesis of Nanoparticles may be intracellular or extracellular according to the location of Nanoparticles[11,12].

Intracellular Synthesis of Nanoparticles by Fungi

Thismethod involves transport of ions into microbial cells to form Nanoparticles in the presence of enzymes. As compared to the size of extracellular reduced Nanoparticles, the Nanoparticles formed inside the organism are smaller. The size limit is probably related to the particles nucleating inside the organisms[13].

Extracellular Synthesis of Nanoparticles by Fungi

Extracellular synthesis of Nanoparticles has more applications as compared to intracellular synthesis since it is void of unnecessary adjoining cellular components from the cell. Mostly, fungi are known to produce Nanoparticles extracellular because of their enormous secretary components, which are involved in the reduction and capping of Nanoparticles[13].

Microbes for Production of Nanoparticles

Both unicellular and multicellular organisms produce inorganic materials either intra- or extracellular[14]. The ability of microorganisms like bacteria and fungi to control the synthesis of metallic Nanoparticles is employed in the search for new materials.

Because of their tolerance and metal bioaccumulation ability, fungi have occupied the center stage of studies on biological generation of metallic Nanoparticles[15].

Types

Silver: Silver Nanoparticles have provedtobemosteffective because of its good antimicrobial efficacy against bacteria, viruses and other eukaryotic micro-organisms [16,17]. They are undoubtedly the most widelyusedNanomaterialsamongall, thereby being used as antimicrobial agents, in textile industries, for water treatment, sunscreen lotions etc [18,19]. Studies have already reported the successful biosynthesis of silver nanoparticles by plants such as Azadirachta Indica[20], Capsicumannuum [21] andCarica papaya [22].

Gold: Gold Nanoparticles (AuNPs) are used in immune chemicalstudies for identification of protein interactions. They are used as lab tracer in DNA fingerprinting to detect presence of DNA in a sample. They are also used for detection of aminoglycoside antibiotics like streptomycin, gentamycin and neomycin. Gold Nanorods are being used to detect cancer stem cells, beneficial for cancer diagnosis and for identification of different classes of bacteria [23,24].

Alloy: Alloy Nanoparticles exhibit structural properties that aredifferent from their bulk samples[25]. Since Ag has the highest electrical conductivity among metal fillers and, unlike many other metals, their oxides have relatively better conductivity [26], Ag flakes are most widely used. Bimetallic alloy Nanoparticles properties are influenced by both metals and show more advantages over ordinary metallic NPs[27].

Magnetic: Magnetic Nanoparticles like Fe3O4(magnetite) andFe2O3 (maghemite) are known to be biocompatible. They have been actively investigated for targeted cancer treatment (magnetic hyperthermia), stem cell sorting and manipulation, guided drug delivery, gene therapy, DNA analysis, and Magnetic Resonance Imaging (MRI)[28].

Applications

Nanomedicine has tremendous prospects for the improvement of the diagnosis and treatment of human diseases. Use of microbes in biosynthesis of Nanoparticles is an environmentally acceptable procedure. Nanotechnology has potential to revolutionize a wide array of tools in biotechnology so that they are more personalized, portable, cheaper, safer, and easier to administer.

Conclusion

Due to their incredible properties, Nanoparticles have become significant in many fields in recent years such as energy, health care, environment, agriculture etc. Nanoparticle technologies have great potentials, being able to convert poorly soluble, poorly absorbed and labile biologically active substance into promising deliverable substances.

Uses

- The use of polymeric micelle Nanoparticles to deliver drugs to tumors.
- The use of polymer coated iron oxide Nanoparticles to break up clusters of bacteria, possibly allowing more effective treatment of chronic bacterial infections.
- The surface change of protein filled Nanoparticles has been shown to affect the ability of the Nanoparticle to stimulate immune responses. Researchers are thinking that these Nanoparticles may be used in inhalable vaccines.
- Researchers at Rice University have demonstrated that cerium oxide Nanoparticles act as an antioxidant to remove oxygen free radicals that are present in a patient's bloodstream following a traumatic injury. The Nanoparticles absorb the oxygen free radicals and then release the oxygen in a less dangerous state, freeing up the Nanoparticle to absorb more free radicals.
- Researchers are developing ways to use carbon Nanoparticles called Nanodiamonds in medical applications. For example, Nano attached can be used to increase bone growth around dental or joint implants.
- Researchers are testing the use of chemotherapy drugs attached to Nanodiamonds to treat brain tumors.
- Other researchers are testing the use of chemotherapy drugs attached to Nanodiamonds to treat leukemia.

References

1. Dubchak S, Ogar A, Mietelski JW, Turnau K (2010) Influence of silver and titanium nanoparticles on arbuscular mycorhiza colonization and accumulation of radio cesium in *Helianthus anus*, Span. J Agric Res8: 103-108.
2. Klaus T, Joerger R, Olsson E, Granqvist CG (1999) Silver-Based Crystalline Nanoparticles, Microbially Fabricated. JProc Natl Acad. SciUSA96:13611-13614.
3. Konishi Y, Ohno K, Saitoh N, Nomura T, Nag amine S, et al. (2007) Bioreductive Deposition of Platinum Nanoparticles on the Bacterium *Shewanella* algae.J Biotechnol128: 648-653.

4. Willner I, Baron R, Willner B (2006) Growing metal nanoparticles by enzymes, J. Adv. Mater18: 1109-1120.

5. Vigneshwaran N, Ashtaputre NM, Varadarajan PV, Nachane RP, Paralikar KM, et al. (2007)Materials Letters61: 1413-1418.

6. Shankar SS, Ahmed A, Akkamwar B, Sastry M, Rai A,et al.(2004) Biological synthesis of triangular gold nanoprism.Nature3: 482.

7. Ahmad N, Sharma S, Singh VN,Shamsi SF, Fatma A, et al.(2011) Biosynthesis of silver nanoparticles from Desmodium triflorum: a novel approach towards weed utilization. Biotechnol Res Int: 1-8.

8. Armendariz V, Gardea-Torresdey JL, Jose Yacaman M, Gonzalez J, Herrera I, et al. (2002) Proceedings of Conference on Application of Waste Remediation Technologies to Agricultural Contamination of Water Resources, Kansas City, Mo, USA.

9. Kim BY, Rutka JT, Chan WC (2010) Nanomedicine, N. Engl.Med363: 2434-2443.

10. Kyriacou SV, Brownlow WJ, Xu XN (2004) Using nano particle optichitosan assay for direct observation of the function of antimicrobial agents in single live bacterial cells.Biochemistry43:140-147.

11. Hulakoti NI, Taranath TC (2014) Biosynthesis of nanoparticles using microbes: A Review. Colloids surf Bio Interfaces 121:474-483.

12. Mann S (2001) Biomineralization, Principles and Concepts in Bioinorganic Materials Chemistry, Oxford University Press, Oxford, UK.

13. Narayanan KB, Sakthivel N (2010) Biological Synthesis of metal nanoparticles by microbes.Advances in Colloid andInterface Science156:1- 13.

14. Shiv Shankara S, Akhilesh Rai, Absar Ahmad, Murali Sastrya (2004) Rapid synthesis of Au, Ag, and bimetallic Au core-Ag shell nanoparticles using Neem (*Azadirachta indica*) leaf brothJ. of Colloid and Interface Science 275: 469-502.

15. Sastry M, Ahmad A, Khan I, Kumar R (2003) Biosynthesis of metal nanoparticles using fungi and actinomycete, Curr Sci85: 162-170.

16. Gong P, Li H, He X, Wang K, Hu J, et al. (2007) Preparation and antibacterial activity of Fe_3O_4@Ag nanoparticles, Nanotechnology18: 604-611.

17. Mahendra Rai, Alka Yadav, Aniket Gade (2009) Silver nanoparticles as a new generation of antimicrobials. Biotech Adv 27: 76-83.

18. Rai M, Yadav A, Gade A (2009)Silver nanoparticles as a new generation of antimicrobials.Biotech Adv27:76-83.

19. Sharma VK, Ria AY, Lin Y (2009) Silver nanoparticles: green synthesis and their antimicrobial activities. Advances in Colloidand Interface Science145: 83-96.

20. Shiv Shankar, Akhilesh Rai, Balaprasad Ankamwar, Amit Singh, Absar Ahmad, et al.(2004) Biological synthesis of triangular gold nanoprisms. Nat Mater 3: 482-488.

21. Bar H, Bhui DK, Sahoo GP, Sarkar P, De SP, et al. (2009) Colloids and Surfaces A, Physicochem. Eng.Aspects339:134-139.

22. Jha AK, Prasad K (2010) Green Synthesis of Silver Nanoparticles Using *Cycas* Leaf. International Journal of GreenNanotechnology: Physics and Chemistry1:110-117.

23. Baban D, Seymour LW (1998) Control of tumor vascular permeability. Adv Drug Deliv Rev34: 109-119.

24. Avnika Tomar, Garima Garg (2013) Short Review on Application of Gold Nanoparticles. Global Journal ofPharmacology7:34-38.

25. Ceylan A, Jastrzembski K, Shah SI (2006) Enhanced solubility Ag-Cu nanoparticles and their thermal transport properties. Metallurgical and Materials Transactions A37: 2033.

26. Jung won Y, Kyoungah C, Byeongjun P, Ho-Chul K, Byeong-Kwon J,et al.(2008) Optical Heating of Ink-Jet Printable Ag and Ag-Cu Nanoparticles. J of Appl Phys 47: 5070.

27. Mohl M, Dobo D, Kukovecz A, Konya Z, Kordas K, et al. (2011) Formation of CuPd and CuPt Bimetallic Nanotubes by Galvanic Replacement Reaction. J Phys Chem115: 9403-9409.

28. Fan TX, Chow SK, Zhang D (2009) Biomorphic mineralization: from biology to materials.Progress inMaterials Science54:542-659.