MedCrave
Step into the World of Research
Journal of Applied Biotechnology & Bioengineering

Short communication

Open Access
CrossMark

Biomedical applications of silver and gold nanoparticles: effective and safe non-viral delivery vehicles

Abstract

Nano-delivery vehicles are known as biochemically engineered nanosized particles having size dimension in the range 1-100nm. These nanomaterials exhibit various novel and unique characteristics such as improved chemical/biological reactivity and sensing ability. These days, many clinical and biomedical scientists are adopting lots of advanced and improved lab practices to enhance the potency, safety and efficiency of gold and silver conjugated plasmid DNA vectors to be used as safe metallo vector tools for achieving site specific delivery of bound desired protein and antibiotic resistance genes in the host in form of colloidal silver/gold nanoparticles and nanoscaffolds. These days, non-viral gene/drug therapies have been become promising diagnostic and therapeutic approach for the treating many genetic, metabolic and neurodegenerative or central nervous system diseases. These non-viral nanomaterials are good choice for effective and safe alternative of gene transfer vehicles/tools to other conventional viral vectors tools due to having low immunogenicity, low toxicity and high tissue specificity for targeted delivery of loaded chemical or biological components. Hence, their clinical and genetic approaches have also been experimented in *in-vivo* and *in-vitro* clinical trials over the last decades that could be used as safe and effective non-viral delivers vehicles.

Keywords: non-viral vehicles, nano biomaterial, immunogenicity, *in-vivo*, retro virus

Volume 3 Issue 2 - 2017

Kirti Rani
Amity Institute of Biotechnology, Amity University Uttar Pradesh, India

Correspondence: Kirti Rani, Assistant Professor (III), Amity Institute of Biotechnology, Amity University Uttar Pradesh, Noida, Sec-125, Gautam Buddha Nagar, Noida-201313 (UP), India, Tel +91-120-4392946, +91-9990329492, Email krsharma@amity.edu, Kirtisharma2k@rediffmail.com

Received: October 25, 2016 | **Published:** May 10, 2017

Abbreviations: AuNPs, gold nanoparticles; AgNPs, sliver nanoparticles; CPPs, cell-penetrating peptides; Poly-A, poly adenine; AuDENPs, acetylated dendrimer-entrapped gold nanoparticles; TFO, triplex forming oligonucleotide

Introduction

Recently, non-viral gene vectors such as nanomaterials of lipoplexes, liposomes and polyplexes have also been used for nanosized diagnostic and therapeutic DNA-based nanomedicine approaches.[1] The penetration of the dye into the hair follicles have been investigated in vitro on porcine skin which is an appropriate model for human tissue and it was found that the nanoparticles penetrate much deeper into the hair follicles than any non-particle form.[2] Developing new non-viral vectors based gene therapies are under considerations gold nanoparticles (AuNPs) and sliver nanoparticles (AgNPs) as nanoconjugates or nanoscaffolds multifunctional nanotools which are prepared by using cationic lipids or polymers as well as these are also found to more promising choice for gene delivery over viral vector delivery like *E. coli*, Lentil virus, Adenovirus, Herpes virus and Retro viruses.[3] This kind of nanoparticles based gene vehicles have low cytotoxicity and excellent biocompatibility with improved transfection efficiency to target the cancer or tumor cells as non-viral gene vectors.[4] Nanobiomaterials have been proposed to be used as non-viral gene delivery using polyethylenimine-coated magnetic nanoparticles and cell-penetrating peptides (CPPs).[5] Non-viral Gene therapy has been recently reported a promising tool to investigate potent and safe anticancer efficacy as improved nanomedicine opportunity to treat cancers or tumours.[6]

Silver nanoparticles (AgNPs)

In past, silver nanoparticles have increasingly attracted more attentions because of their promising applications in the fields of catalysis use of silver based nanocolloids have been reported to control the absorption of scattering species when these silver nanoparticles were reduced by using borohydride.[7,8] Silver nanoparticles (AgNPs) were endorsed for biomedical applications. Recently, biomedical researcher were notices that silver nanoparticles (AgNPs) have high bactericidal efficacy against *Escherichia coli, Neisseria gonorrhea, Chlamydia trachomatis* and other pathological viruses that have been proposed for gene delivery systems for tissue previously.[9] Nucleic acid conjugated photo labile silver nanoparticles (AgNPs) nucleic acid was used for the inducible gene silencing for delivery of antisense oligonucleotides.[10] Silver nanoparticles (AgNPs) based oiligonucleotide-thiol conjugates and poly adenine (poly-A) DNA functionalized gold nanoparticles (AuNPs) have been subjected to nanofabrication for attaching high density of DNA that have high hybridization ability to facilitate the improved recognition for hybridization as vital plasmonic biosensor.[11] Montmorillonite conjugated silver nanoparticles (AgNPs) have been found to observe better choice for loading the plasmid pcDNA-GFP to achieve targeted gene delivery.[12]

Gold nanoparticles (AuNPs)

Gold nanoparticles (AuNPs) were reported to be an attractive nanoscaffold as nontoxic delivery vehicle. Transmission Electron Microscope analysis of gold nanoparticles (AuNPs) have been performed on skin samples and their chemical analysis was done

by using Inductively Coupled Plasma-Mass Spectrometry which demonstrated the presence of gold nanoparticles (AuNPs) into epidermis and dermis. This study was showed that gold nanoparticles (AuNPs) are vital delivery medium to penetrate the human skin in an in vitro diffusion cell system.[13] Surface fabrication of gold nanoparticles (AuNPs) as nano-delivery vehicles was done with their grafting with fabrication of active functional groups e.g., polyethylene glycol and zwitterions to enhance their plasma protein adsorption, improving the pharmacokinetics and evading immune observations.[14] Oligonucleotide and small interfering RNA-modified gold nanoparticles (AuNPs) conjugates were reported more effective and safe intracellular gene regulation agents to activate immune-related genetic pathways.[15] AuNPs-nanoscaffold have been reported an attractive scaffold for nucleic acid delivery that have effective endosomal entrapment and active delivery expression potential in the host genome.[16,17] Gold nanoparticles (AuNPs) coupled Ad vector system might have been considered an ideal nano vehicle for safe targeting, imaging and combined hyperthermia in tumor gene therapy.[18] Partially acetylated Dendrimer-entrapped gold nanoparticles (AuDENPs) delivery system was also proposed for safe gene delivery biomedical approach with improved gene transfection efficiency.[19] Recently, gold nanoparticles conjugated c-myc promoter-triplex-forming oligonucleotide (TFO) and cationic gold nanoparticles were used for improved transgene expression efficacy and intranucleus non-viral gene delivery biomedical tools.[20,21]

Conclusion

So, this short review article is based on biomedical applications of silver nanoparticles (AgNPs) and gold nanoparticles (AuNPs). In last decades, various biomedical findings were carried out on lethal and deleterious side effects of viral based gene delivery due to having their pathogenicity with the time in the targeted host cells. And, it was concluded that metallo/polymer based conjugates or nanoscaffolds or nanotools were less toxic and more biocompatible over other conventional viral gene delivery tools that used in biomedical approaches. Among them, gold nanoparticles (AuNPs) and silver nanoparticles (AgNPs) conjugates were reported safer and vital non-viral delivery vehicles with the ease of their fabrication, high biocompatibility and photoluminescent efficiency in host cell metabolism. Hence, this short review article might be helpful for highlighting biomedical applications of gold nanoparticles (AuNPs) and silver nanoparticles (AgNPs) as safe non-viral gene delivery vehicles.

Acknowledgements

None.

Conflict of interest

The author declares no conflict of interest.

References

1. Ramamoorth M, Narvekar A. Non viral vectors in gene therapy- an overview. *J Clin Diagn Res*. 2015;9(1):GE01–GE06.
2. Lademann J, Richter H, Teichmann A, et al. Nanoparticles--an efficient carrier for drug delivery into the hair follicles. *Eur J Pharm Biopharm*. 2007;66(2):159–164.
3. Jin L, Zeng X, Liu M, et al. Current progress in gene delivery technology based on chemical methods and nano-carriers. *Theranostics*. 2014;4(3):240–255.
4. Blasiak B, Van Veggel FCJM, Tomanek B. Applications of nanoparticles for MRI cancer diagnosis and therapy. *Journal of Nanomaterials*. 2013;2013:1–12.
5. Huang YW, Lee HJ, Tolliver LM, et al. Delivery of nucleic acids and nanomaterials by cell-penetrating peptides: opportunities and challenges. *Biomed Res Int*. 2015;2015:834079.
6. Sun NF, Liu ZA, Huang WB, et al. The research of nanoparticles as gene vector for tumor gene therapy. *Crit Rev Oncol* Hematol. 2014;89(3):352–357.
7. Cermakova K, Sestak O, Matejka P, et al. Surface-enhanced raman scattering spectroscopy with borohydride-reduced silver colloids: controlling absorption of scattering species by surface potential of sliver colloids. *Collect Czech Chem Commun*. 1993;58:2682–2694.
8. Musi A, Massiani P, Brouri D, et al. On the characterisation of silver species for SCR of NO_x with ethanol. *Catal Lett*. 2009;128(1):25–30.
9. Marin S, Vlasceanu GM, Tiplea RE, et al. Applications and toxicity of silver nanoparticles: a recent review. *Curr Top Med Chem*. 2015;15(16):1596–1604.
10. Brown PK, Qureshi AT, Moll AN, et al. Silver nanoscale antisense drug delivery system for photoactivated gene silencing. *ACS Nano*. 2013;7(4):2948–2959.
11. Lu W, Wang L, Li J, et al. Quantitative investigation of the poly-adenine DNA dissociation from the surface of gold nanoparticles. *Sci Rep*. 2015;5:10158.
12. Sironmani A. Comparison of nanocarriers for gene delivery and nanosensing using montmorillonite, silver nanoparticles and multiwalled carbon nanotubes. *Applied Clay Science*. 2015;103:55–61.
13. Filon FL, Crosera M, Adami G, et al. Human skin penetration of gold nanoparticles through intact and damaged skin. *Nanotoxicology*. 2011;5(4):493–501.
14. Ding Y, Jiang Z, Saha K, et al. Gold nanoparticles for nucleic acid delivery. *Mol Ther*. 2014;22(6):1075–1083.
15. Conde J, Ambrosone A, Sanz V, et al. Design of multifunctional gold nanoparticles for in vitro and in vivo gene silencing. *ACS Nano*. 2012;6(9):8316–8324.
16. Mieszawska AJ, Mulder WJ, Fayad ZA, Multifunctional gold nanoparticles for diagnosis and therapy of disease. *Mol* Pharm. 2013;10(3):831–847.
17. Yah CS. The toxicity of Gold Nanoparticles in relation to their physiochemical properties. *Biomedical Research*. 2013;4(3):400–413.
18. Saini V, Martyshki DV, Towner VD, et al. Limitations of adenoviral vector-mediated delivery of gold nanoparticles to tumors for hyperthermia induction. *Open Nanomed J*. 2014;2.
19. Hou W, Wen S, Guo R, et al. Partially acetylated dendrimer-entrapped gold nanoparticles with reduced cytotoxicity for gene delivery applications. *J Nanosci Nanotechnol*. 2015;15(6):4094–4105.
20. Huo S, Jin S, Ma X, et al. Ultrasmall gold nanoparticles as carriers for nucleus-based gene therapy due to size-dependent nuclear entry. *ACS Nano*. 2014;8(6):5852–5862.
21. Uthaman S, Moon MJ, Lee D, et al. Di-sulfide linked polyethylenimine coated gold nanoparticles as a non-viral gene delivery agent in NIH-3T3 mouse embryonic fibroblast. *J Nanosci Nanotechnol*. 2015;15(10):7895–7899.

Citation: Rani K. Biomedical applications of silver and gold nanoparticles: effective and safe non-viral delivery vehicles. *J Appl Biotechnol Bioeng*. 2017;3(2):296–297. DOI: 10.15406/jabb.2017.03.00059