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USE OF GOLD NANO-PARTICLES FOR MEDICINAL USE -A REVIEW

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ABSTRACT

Gold nanoparticles are versatile materials with a broad range of applications in a variety of fields. Gold based nanoparticles, owing to their unique optical properties at the nanoscale, biocompatibility, and rich surface chemistry, have attracted considerable attention from the material science and biomedical community. Biomedical applications of gold nanoparticles Nanosized gold has potential applications in every sphere of medicine, whether it is in the identification of unique biochemical signature of a disease or a diseased cell circulating in the blood, or in the immunization of an individual as a safeguard against invasion by a pathogen such as a virus, or in the early diagnosis and treatment of cancer. Gold nanoparticles may be used in different domains, one of most important being the biomedical field. They have suitable properties for controlled drug delivery, cancer treatment, biomedical imaging, diagnosis and many others, due to their excellent compatibility with the human organism, low toxicity and tunable stability, small dimensions, and possibility to interact with a variety of substances. gold nanoparticles have been showed a great potential to be used as drug delivery systems. Gold nanoparticles are intensively studied in biomedicine, and recent studies revealed the fact that they can cross the blood-brain barrier, may interact with the DNA and produce genotoxic effects. Because of their ability of producing heat, they can target and kill the tumors, being used very often in photodynamic therapy. Gold nanoparticles can be synthesized in many ways, but the most common are the biological and chemical methods, however the chemical method offers the advantage of better controlling the size and shape of the nanoparticles. In this review, we present the principal applications of gold nanoparticles in the biomedical field, like cancer treatment, amyloid-like fibrillogenesis inhibitors, transplacental treatment, the development of specific scaffolds and drug delivery systems.

Keywords- *Gold, NanoParticles, Biomedical.*

I. INTRODUCTION

Gold nanoparticles are particles with diameters in the 1-100nm range and have unique optical and physical properties, the most pronounced being the intense absorbance and scattering of incident light at its surface plasmon resonance wavelength. The optical properties of gold nanoparticles are governed by their morphology, i.e. size, shape and aggregation status. By precisely engineering particles with different morphologies and surface chemistries, these particles can be tuned to suit a variety of applications making them a very versatile research and diagnostic tool. For example, the gold nanoparticle surface can readily be functionalized with peptides, proteins and antibodies providing them with specificity toward cellular targets both in vitro and in vivo. In addition, modifying the surface with oligonucleotides enables them to be used for genetic detection. Common applications include their use in immunohistochemistry, bio imaging, biosensors, lateral flow assays, as cellular probes, and as vehicles for drug delivery.

Nano particles as a drug delivery system enable unique approaches for cancer treatment Nano particles have optical magnetic chemical and structural properties that set them apart from bulk solids, with potential application in medicine gold(Au),nanoparticles(aunps) exhibit a combination of physical and chemical optical and electronics properties. Gold nano particles place a multifunctional role in image and diagnose diseases delivered of therapeutic agent.

Gold nano Particle: Mediated thermal therapies:

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Gold nano particles are emerging as promising agent for cancer therapy these are beneficial in diagnosis of cancer due to their photo physical property and optical property.
This therapy will work on any soft tissues tumors such as the breast, prostate, brain, skin head, neck and cervix.
Gold nano particles occurs as clusters of gold atoms up to 100nm in diameter

Characteristics Of Gold Nano Particles

- They are chemically inert
- These have greater biological compatibility they provide microscopic probes for the study of the cancer cell
- These have high stability due to the gold sulfur bond

Applications

Gold nanoparticles are versatile materials with a broad range of applications in a variety of fields. Researchers have coated gold particles with DNA and injected them into plant embryos or plant cells. This will ensure that some genetic material will enter the cells and transform them. This method enhances plant plastids.

The July 2007 issue of Analytical Chemistry reported that scientists from Purdue University were able to use gold nanoparticles to detect breast cancer. Later it was also discovered that the nanoparticles could detect toxins and pathogens.

The optical-electronics properties of gold nanoparticles are being explored widely for use in high technology applications such as sensory probes, electronic conductors, therapeutic agents, organic photovoltaic's, drug delivery in biological and medical applications, and catalysis.

Other applications of gold nanoparticles are listed below:

- As an anti-biotic, anti-fungal, and anti-microbial agent when added in plastics, coatings, nanofibers and textiles
- In nanowires and catalyst applications
- In therapeutic agent delivery
- To connect resistors, conductors, and other elements of an electronic chip
- In photodynamic therapy - When light is applied to a tumor containing gold nanoparticles, the particles rapidly heat up, killing tumor cells
- In various sensors, e.g. colorimetric sensor with gold nanoparticles can identify if foods are suitable for consumption
- As substrates to enable the measurement of vibrational energies of chemical bonds in surface enhanced Raman spectroscopy
- The scattered colors of gold nanoparticles are currently used for biological imaging applications

II. DISCUSSION

Uses of Gold Nano Particles

Precious metals and their compounds as therapeutic agents, particularly of gold, have a long and distinguish history in medicine. The use of gold in medicine has evolved over thousands of years. In China, gold was used in the treatment of ailments such as smallpox, skin ulcers and measles. In Japan, thin gold foils placed in tea, sake and food were seen as beneficial to health. In Bangladesh-Pakistan India, traditional Ayurvedic medicines are still used widely with gold taken as a 'rejuvenator' by millions of people each year.

A typical daily dose includes 1-2mg of gold incorporated into a mixture of herbs. As medical science and medicine have advanced, so too the biomedical uses and applications of gold. Over the years, the gold nanoparticles have become more precious than pretty gold. Most important reason be detected using X-rays, allowing doctors to target the position of the prostate within one or two millimeters and thereby allow a more precise dose of radiation to be administered to a more targeted area for the treatment of the tumor. While this is a relatively new application, radioactive gold was used in some of the very first treatments of cancer dating back to 1955.

In Medicine More recently, new technologies have used the ability of tiny gold nanoparticles to collect specifically in a cancerous tumor by passing through the inherently leaky blood vessels attached to a tumor. Thus, when injected into a patient, there is a means by which a potent anticancer compound attached to a gold nanoparticle can be delivered directly and accurately to a tumor while avoiding surrounding healthy tissues. Such an effective drug delivery mechanism with reduced toxicity is considered to be a major step forward in cancer treatment, limiting side effects such as reduced immunity and hair loss.

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Two types of gold nanoparticle shapes are more efficient in converting light into heat:

- **Gold nanorods:** These solid cylinders of gold have a diameter as small as 10 nm. By using nanorods with different combinations of diameter and length, researchers can change the wavelength of light that the nanorod absorbs.
- **Nanospheres consist of a gold coating over a silica core:** By using nanospheres with variations in the thickness of the gold coating and the diameter of the silica core, researchers can change the wavelength of the light that the nanosphere absorbs.

Various researchers are using either nanorods or nanospheres to develop methods for localized heat treatment of diseased regions of the body. This method is called hyperthermia therapy.

Here's a list of the types of things nano is making possible today. Nano is being used

- To make strong lightweight equipment ranging from tennis racquets to windmill blades
- To clean up industrial solvents contaminating groundwater
- To protect clothing with nanoparticles that shed water or stains
- As catalysts to make chemical manufacturing more efficient while saving energy and keeping waste products to a minimum
- As a coating on countertops that kills bacteria
- In sunscreens to provide protection from UV rays without producing a thick white residue
- In wound dressings to rapidly stop bleeding in trauma patients
- As a film on glass to stop water from beading and dirt from accumulating
- In paints to prevent corrosion and the growth of mold as well as to provide insulation
- To make integrated circuits with features that can be measured in nanometers (nm), allowing companies to make computers chips that contain billions of transistors
- In bandages to kill germs
- For coatings in heavy-duty machinery, such as ships and the oil industry, to make equipment last longer
- In plastic food packaging to keep oxygen out so the food spoils at a much slower rate

Future Uses

The future of medicine Study of medical history reveals a long, hard struggle to improve human health, a struggle that will ultimately culminate in a grand victory; the elimination of ill health and suffering in the 21st Century. Assuming that the approximately ten billion people who have ever lived survived an average of 40 years and spent just 2% of their lives in misery and sickness from disease, and then a not inconsiderable price of ~70 trillion man-hours of human suffering will have been paid to achieve this end. Biotechnology and genetic engineering are comparatively well-known because of their many important successes over the last several decades. But advocates of these approaches often ignore a future post-biotechnology discipline, just now appearing on the 2-3 decade R&D horizon, that can almost guarantee whole-body elimination of biological senescence and the indefinite maintenance of healthy mind and body, while producing few if any unwanted medical side effects. This new technology involves the application of molecular nanotechnology and nanorobotics to human health care. In near future, it will become increasingly clear that all of biotechnology is but a small subset – albeit an important subset – of nanotechnology. Indeed, the 21st century will be dominated by nanotechnology – the engineering and manufacturing of objects with atomic-scale precision – not biotechnology. Humanity is poised at the brink of completion of one of its greatest and most noble enterprises. Early in the 21st century, our growing abilities to swiftly repair most traumatic physical injuries, eliminate pathogens, and alleviate suffering using molecular tools will begin to coalesce in a new medical paradigm called nanomedicine. Nanomedicine may be broadly defined as the comprehensive monitoring, control, construction, repair, defense, and improvement of all human biological systems, working from the molecular level, using engineered nanodevices and nanostructures, molecular machine systems, and – ultimately – nanorobots too small for the eye to see. Molecular nanotechnology refers to the three-dimensional positional control of molecular structure to create materials and devices to molecular precision. The human body is comprised of molecules; hence the availability of molecular nanotechnology will permit dramatic progress in human medical services. More than just an extension of "molecular medicine," nanomedicine will employ molecular machine systems to address medical problems, and will use molecular knowledge to maintain and improve human health at the molecular scale. The body is constantly under assault from the environment, and the immune system is continually waging a silent war against these threats. Toxins, bacteria, fungi, parasites and viruses are all constantly attacking the body and trying to do it harm. Many nanotechnological techniques imagined only a few years ago are today already making remarkable progress toward becoming reality. Scientists are currently exploring how to put to use dendrimers, (branched spherical molecules) carbon buckyballs, and other specifically engineered nanoparticle drugs to combat everything from bacteria and viruses to cancer. Nanoshells could also be used to concentrate infrared (laser) light to heat, and thereby selectively destroy cancerous cells. It may become possible to orally administer drugs that can currently only be delivered by injection. Nanoparticle encapsulation of the drug will help it to easily pass through the stomach lining and into the bloodstream where its payload would be released. Inhaled nanofibers can even stimulate the regeneration of cartilage in damaged joints. The true potential power of nanomedicine, however, lies in still theoretical, biology, and most current causes of natural human death - forever severing the link between calendar age and physiological health. If you are biologically old, and do not wish to be, then for you, aging/being old is a disease, that you deserve to be cured of. Through a combination of nanobot therapies, say once a year or less frequently, accumulated metabolic toxins and other nondegradable material will be cleansed from your body, while chromallocytes delete any genetic mutations or damage. Any remaining structural damage to cells that they are unable to auto-repair such as disabled or enlarged mitochondria will be dealt with using dedicated cellular repair nanobots. These rejuvenation procedures will need to be repeated once a year (or less frequently) to revert all of the damage that occurs on a continual basis as a result of metabolism. Clottocytes are a design for micron-scale, oxygen/glucose-powered, artificial mechanical platelets. Clottocytes would be 100 to 1,000 times faster in response than the body's natural platelets, stopping bleeding almost instantly (within about one second) even in the event of fairly large wounds. The clottocyte is conceived as a two micron diameter, spheroidal nanobot that contains a tightly-folded (biodegradable) fiber mesh payload which, when commanded by its internal nanocomputer, deploys in the general vicinity of a damaged blood vessel. Certain parts of the mesh are designed to dissolve exposing sticky sections upon contact with water in the blood plasma. The overlapping nettings of multiple activated clottocytes trap blood cells and stop bleeding immediately. The clotting function performed by clottocytes is essentially equivalent to that of biological platelets, albeit at just 1/10,000th the concentration in the bloodstream, (or approximately 20 nanobots/ cubic centimeter of blood.) and much quicker acting. DNA can be considered to be biological nanosoftware; ribosomes, large scale molecular constructors. Enzymes are what Nature chose as truly functional molecular sized assemblers. Genetic engineers are not creating new tools per se, but rather, adapting and improvising from what Nature has already provided. Future generations of engineers, armed with molecular engineering techniques, will have a real chance of imitating and perhaps improving upon Nature. Nanobots can also be designed and constructed with absolute atomic precision - a level of perfection that is actually beyond that which say, an entire natural cell operates on. Practically every atom in nanobot will have a particular function in the overall structure. Intelligent design of the human variety can now be much more direct and efficient than nature - but it took nature to get us this far.

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III. 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.

Gold nanoparticles are prepared by various methods and used in different fields including drug delivery, sensing, and detection. The wide applicability is due to their extremely chemical and physical, high surface area, tunable optical, stability, properties small size, and non-cytotoxicity. Functionalized gold nanoparticles with different biomolecules such as proteins, DNA, amino acids, and carboxylic acids have been used in cancer therapy and provide excellent drug delivery system. Targeted gold nanoparticles delivery interacts with the cancerous cell. Side effects of conventional drugs have been minimized by conjugation with gold nanoparticles. Ag/NPs have proven worthy in inhibiting the microbial proliferation and microbial infection. Furthermore, Ag/NPs have added a new dimension in the field of medicine concerning wound dressing and artificial implantation and in preventing contamination caused by microbes. Apart from that, Ag/NPs play a pivotal role and are considered as important ingredients in the preparation of commercially used products in industries.

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