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NANOPARTICLES: A NOBEL REVOLUTIONARY INVENTION FOR BIOMEDICAL SCIENCES

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Abstract: *Nanotechnology is the nano-scale-based science and technology. Nanotechnology is the understanding and control of matter at dimensions of approximately 1to100 nanometers. Nanotechnology includes various fields; this idea entails its applications to diverse fields of Biomedical Sciences. Nanoparticles have revolutionary applications for diagnosis to treatment of various types of diseases. These nano-particles, nano-rods, quantum dots, nano-wires, and carbon nano-tubes in diagnostics cell labeling, biomarkers, and contrast agents for biological imaging, drug delivery systems, and nano-drugs are the advanced uses for treatment of infectious and non-infectious diseases. This research review tries to summaries the most recent progress in the field of significance of nanoparticles in field of biomedical sciences for the empowerment of Bio-Life.*

Key Words *Nanoparticles, Nanotechnology, Biomedical Sciences*

Introduction

The term nanoscience and nanotechnology firstly explained by famous physicist and father of nanotechnology Richard Feynman. He was talked on "There's Plenty of Room at the Bottom" at American Physical Society meeting at the California Institute of Technology (CalTech) on December 29, 1959, During this talk he firstly introduce term Nanotechnology. After some period this term "Nanotechnology" was coined by Professor Norio Taniguchi, Tokyo Science University in 1974. They describe the precision manufacture of materials with nanometers tolerances and was unknowingly appropriated by Drexler in his book "Engines of Creation: The Coming Era of Nanotechnology" on 1986 [18].

Nature is filled with various objects that function on micro to nano scale. A particle

is a small, contained object that performs as a whole unit and can be described using physical properties such as volume, size and mass. A nano-particle is "a particle having one or more dimensions of the order of 100 nm or less." Ultrafine particles or nanoparticles range in sizes between 100 and 1 nanometers. Nanoparticles can be defined as particulate dispersions or solid particles with a size in the range of 10-1000nm The National Science and Technology Council of United States of America (2004). Nanotechnology applications to the life sciences include pharmaceuticals, biotechnology, medical devices, diagnostics, gene therapy, drug delivery and tissue engineering [20, 21, 24, and 25]. Nanoparticles are used in various fields; this research review mainly focused on nanoparticles is the Nobel Revolutionary Invention for Biomedical Sciences.

Nanoparticles in Biomedical Sciences

Nanotechnology and Biology are strongly interlinked. Various biological systems are with the nanoscale dimensions. Like, the diameter of DNA molecule is around 2 nm and size range of many enzymes is few nanometers. Applications of Nanotechnology in life sciences ranges from detection of pathogens and biomolecules, drug and gene delivery, diagnostic and treatment of cancer, tissue engineering and creation of nanostructures mimicking biomolecules. Their some most important applications of nanoparticles are involved biomedical sciences, such as drug and gene delivery, cancer treatment and diagnostic tools, food etc. They have been extensively studied throughout the past decade. Nanoparticles are created a huge interest due to their very small size and large surface-to-volume ratio, and they display absolutely novel uniqueness contrast to the large particles of bulk material [15].

Nanoparticles for Detection of Biomarkers

The determination and diagnosis of various diseases, the nanoparticales are plays an important role in the form of biomarkers. Biomarkers are molecules that can be measured in blood, other body fluids, and tissues to assess the presence or state of a disease. They have the potential to help us detect cancer earlier stage and determine a tumor's aggressiveness, or predict a patient's response to a particular treatment [36]

Nanoparticles in Food and Cosmetics

Nanofood is a term used to describe foods that use nanotechnology techniques, tools or manufactured nanomaterials. That has been added during cultivation, production, processing or packaging for the development of nanofood. These include improvement of food safety, enhancement of nutrition and flavor, reasonable production costs. In addition, nanofood provides various benefits by which include health promoting additives, longer shelf lives and new flavor varieties. These same nanoparticles are also used in food packaging to reduce UV exposure and

prolong shelf life. The application of nanotechnology in food is rapidly emerging and is involving all areas of the food chain from agricultural applications to food processing and enhancing bioavailability of nutrients.

All developing countries emerging for cost-efficient, portable water treatment systems are the burning issue. For improving the drinking water quality, Water filters that are only 15-20 nanometers wide can remove nano-sized particles, including virtually all viruses and bacteria. Near about all sunscreen creams and lotions today are made from nanoparticles. They have been effectively absorbing light, including the extremely hazardous ultraviolet range. They also spread more easily over the skin. These nanoparticles in pharmaceutical products improve their absorption within the body and make them easier to deliver, often through combination medical devices.

Nanoparticles in Drug Delivery

Recently, nanoparticles have gained significance in the field of biomedicine [38]. There are many potentially valuable prospects in Nanoparticles and nanotechnology for drug delivery systems has potential application in medical field including diagnostics and therapeutics [26]. The nanoparticles get trapped to drugs are enhanced delivery to, or uptake by, target cells and or a reduction in the toxicity of the free drug to non-target organs [40]. The advantageous areas in which nanotechnology efforts are being made include vaccine adjutants and delivery systems, nanostructured applications used in orthopaedics and wound management [12, 22, and 33]. These controlled release drug delivery system, delivery vehicles that have been enhance circulation and targets of drug and to specific cells, systems that improve the solubility of poorly water soluble drugs [3,6, 29, 30 and 37]. Some drug delivery systems as follows:

Polymer Nanoparticles

This delivery system is being used for many pharmaceuticals drugs which are not soluble in water, inefficiency towards specific target site. For example; include PEGylated liposomal nanoparticle formulation of GMP-grade WHI-P131 exhibited potent in vivo activity shows therapeutic potential against breast cancer than chemotherapy drugs like paclitaxel, gemcitabine [6].

Quantom Nanodots

These quantum nanodots can be mainly used in biological applications and labelling of biomolecules. Flouroscent invisible nanocrystals measuring around 2-10nm smaller than the wavelength of visible light made to fluorescence stimulated by light have range of health applications for tracing the course of therapeutic drugs or establishing circulatory problems in the human body for example; Illustrations incorporate chitosan (N-(2- hydroxyl) propyl-3-trimethyl ammonium chitosan chloride, HTCC/CdS quantum nanodots can be possibly utilized as a part of organic

applications and naming of biomolecules [19].

Nanoparticles for Vaccine Formation

It is an alternative to traditional biological vaccine formation method in which nanovectors developed. These systems proved to be very successful as nanovectors are used to trigger the body's immune system. For example; a number of systems have been developed in the UK, particularly for Influenza Vaccine [16].

Nanofabricated Structures for Diagnostics

Today's advanced techniques in diagnosis; nanofabrication is the unique diagnostics where nanofabricated surface structures are used as permeable layers so that they don't allow unnecessary molecules to pass through it [17]. These molecular diagnostics are requires small amount of sample, less time, quick process and reliable for different kinds of analysis [8, 9 and10]. There are different lab-on-a-chip devices already available in the market for analytical purposes. Eg: "Gluco-watch" which permeates your skin with fluidic nanochip biosensors that sense the level of blood Lab-on-a-chip technology. Which is the basis for combinatorial screening techniques, which, when combined with powerful computers can dramatically speed up the new drug discovery process [1, 4, 8, 14, 19, 23, 31, 34, 35 and 39]

Nanoparticles in Tissue Engineering

The recent developing and revolutionary area of nanotechnology is Tissue Engineering. In developed countries, nanotechnology will have commercial importance [13, 27, 28, and 32]. This Tissue Engineering can be used to grow tissues & organs artificially on nanopatterned scaffolds, Medical devices include contact lenses require surface topography measurement at the nano-level to verify shape and intended optical profiles using nanostructured materials and functionalized surfaces [2]. In future, nanorobots will do targeted therapeutic jobs [7].

Nanoparticles in Gene Delivery

Gene delivery it is a technique that plays a vital role that can efficiently introduce a gene of interest in order to express its encoded protein in a suitable host or host cell. Today's Fast upgradation in techniques, there are number of primary gene delivery systems. These delivery systems are mainly employing viral vectors like retroviruses and adenoviruses, nucleic acid electroporation, and nucleic acid transfection [5].

Nanoparticle in Cancer Treatment

A nanoparticle system has a wide range of applications but currently under investigation to be applied in biomedical with the emphasis on cancer therapeutics. The unique up conversion process of UCNPs may be utilized to activate photosensitive therapeutic agents for applications in cancer treatment [15]. The use of polymer coated iron oxide nanoparticles to break up clusters of

bacteria, possibly allowing more effective treatment of chronic bacterial infections. Nanoparticles can also be used to deliver chemotherapy drugs to specific cells, such as cancer cells. The surface change of protein filled nanoparticles has been shown to affect the ability of the nanoparticle to stimulate immune responses. Various investigations shows that use of chemotherapy drugs attached to nanodiamonds to treat leukemia. A percentage of the cases incorporate PEGylated liposomal nanoparticle detailing of GMP-evaluation WHI-P131 showed intense in vivo action shows helpful potential against bosom tumor than chemotherapy medications like paclitaxel, gemcitabine. [6].

CONCLUSION

Nanotechnology is a thrilling field which has tremendous potential to develop new science. The present brief review article mainly focused on advanced role of nanoparticles in the field of biomedical sciences. Nanoparticles have revolutionary applications for diagnosis to treatment of various types of diseases. These nano-particles, nano-rods, nano-wires, quantum nano-dots, and carbon nano-tubes in diagnostics cell labeling, biomarkers, and contrast agents for biological imaging, drug delivery systems, and nano-drugs are the advanced uses for diagnose precaution and treatment of therapeutic and non therapeutic diseases. This article tries to summaries briefly on Nanoparticles are the noble revolutionary invention for biomedical sciences which is empower our Bio-Life.

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