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APPLICATION AND CHALLENGES OF NANO-BIOTECHNOLOGY

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Abstract
Nanotechnology is defined as the study and use of structures between 1 nanometer and 100 nanometers in size. To give you an idea of how small that is, it would take eight hundred 100 nanometer particles side by side to match the width of a human hair.
Nanobiotechnology is the application of nanotechnology in biological fields. Nanotechnology is a multidisciplinary field that currently recruits approach, technology and facility available in conventional as well as advanced avenues of engineering, physics, chemistry and biology.In this paper we will study application and challenges of nano-biotechnology
Keywords: Nanopharmaceutical,Drug and gene delivery,Targeted therapy,Lipid-based nanoparticles (LBNs),Polymer-based nanomaterials,Metal-based nanomaterials,Clinical trial,Food and Drug Administration (FDA) approved nanomaterials,Carbon-based nanomaterials (CBNs),Nanogel-based nanomaterials

Introduction:-
At present, nanotechnology has been widely applied to the area of drug development. Nanoparticle-based therapeutics has the ability to overcome biological barriers and to deliver hydrophobic drugs and biologics effectively to the target sites of disease. The complexity of nanoparticles as multi-component 3D structures require careful design and engineering and reproducible scale-up and manufacturing process to achieve a consistent product. The safety and efficacy of nanoparticle-based medicines can be influenced by minor variations in multiple parameters and need to be carefully examined in preclinical and clinical examinations. Finally, nanoparticle-based medicines may have to represent additional development challenges and regulatory considerations compared with conventional medicines. Efforts are being made to produce unique category of therapeutic agents while there is generally a lack of regulatory standards in the examination of nanoparticle-based medicines. Rapid DNA sequencing.Single-stranded genomic DNA or RNA.Organic and inorganic nano composites.Safety and risk assessment of nanotechnology.
Bionanotechnology is defined as the incorporation of biological molecules into nanoartifacts. The highly refined molecular binding specificity is particularly valued and used to facilitate the assembly of unique structures from a solution of precursors and for capturing chemicals from the environment prior to registering their presence via a transducer (biosensors). Further applications involve using the widely encountered ability of biomolecules to easily accomplish actions associated with difficult and extreme conditions in the artificial realm, such as the catalysis of many chemical reactions, and exploiting optical nonlinearity with single photons, a feature that can be exploited to construct all-optical computers.

Bionanotechnology is a science that sits at the convergence of nanotechnology and biology. Nanobiology and nanobiotechnology are other names that are used interchangeably with bionanotechnology. The field applies the tools of nanotechnology to biological problems, creating specialized applications.
The field of biotechnology is focused on basic research into the mechanisms of disease toward the development of new therapeutic and diagnostic devices. Bionanotechnology applications within biotechnology include the development of microfluidic devices for high throughput drug discovery assays, nanotechnology-based drug delivery devices, genome sequencing, proteomics, and imaging.
One example is the use of nanoparticles for drug delivery. A therapeutic is chemically attached to the nanoparticle. Radio or magnetic signals are then used to guide it to its target in the body. Precisely targeted drug delivery enhances efficacy and side effects due to off-target activity.
Gene delivery is another area of active research in bionanotechnology. Nanoparticle-based non-viral vectors of about 50 to 500 nm have been studied for delivery of plasmid-based DNA for gene therapy.
Purpose designed nanomachines could be used to provide breakthrough treatments for many diseases. Medical nanomachines programmed to recognize and disassemble cancerous cells could be injected into the bloodstreams of

cancer patients, thus providing quick and effective treatment for all types of cancers. Nanobiotechnology could be used to repair damaged tissues and bones and even be used to strengthen bones and muscle tissues by providing molecular support structures by reassembling nearby tissues. And since nanomachines and nanoparticles will be designed to make copies of themselves, these treatments will be inexpensive and available to the entire population. It can also help creating smart drugs loaded onto nanoparticles leading to more specific delivery of biologically active compounds to enhance drug efficacy and reduces drug toxicity. These help cure people faster and without the side effects that other traditional drugs have. The research of nanobiotechnology in medicine is now focusing on areas like tissue regeneration, bone repair, immunity and even cures for such ailments like diabetes, cancer and other life threatening diseases. Nanosystems have capacity of selective localization in inflammed tissues. Various nanoproducts can be accumulated at higher concentration than normal drug.

The difference between nanotechnology and biotechnology

Thus one fundamental difference between biotechnology and nanotechnology is the nature of the materials.

Biotechnology uses biomolecules and organisms to develop pharmaceutical therapies, medical treatments and research, and agricultural innovations. The molecules used may include antibodies, nucleic acids such as DNA and RNA, proteins and hormones, viruses, human cells and bacteria, and plant cells. While biomolecules are typically within a range of 3-15 nm in size, human cells and plant cells may measure up to 25 microns and 100 microns respectively, at their largest.

Nanotechnology uses manmade and inorganic materials, which are typically less than 100 nm in size.

The other difference is the kind of applications that the material or molecule is used for.

Biotechnology applies itself to life sciences.

Nanotechnology is usually bent on computational increments or advances, better electronic performance, and the production and storage of energy for various applications.

However, these fields do overlap in some areas. These are called nano biotechnology and bionanotechnology, and they are not identical.

Nano biotechnology deals with technology which incorporates nano molecules into biological systems, or which miniaturizes biotechnology solutions to nanometer size to achieve greater reach and efficacy. This may result in more effective and inexpensive assays and therapies. Biomolecules are often added to the outside of nanoparticles to target or make use of specific molecules for a given purpose. These hybrid nanostructures are used to make biosensors or to image certain body parts. Nanostructures can also be engineered to incorporate them into body systems by altering their solubility in water, compatibility with biologic material, or recognition of biological systems. To give one example, DNA is typically difficult to insert into a cell nucleus because of its strand-like form. However, if it is mounted on a spherical nanoparticle the spherical DNA may pass through the cell and nuclear membrane with ease. Antibodies and proteins may also be used to coat nanomolecules such as carbon tubes or gold nanoparticles for easy and rapid bioassays.

Bionanotechnology, on the other hand, deals with new nanostructures that are created for synthetic applications, the difference being that these are based upon biomolecules. In other words, the building blocks out of which the nanostructure is made are antibodies, nucleic acids or other molecule of life. The molecules used are typically self-assembling and have a highly predictable pattern of binding. This makes them ideal for the purpose of building functional nanostructures, which can be used for various nanotechnological applications such as the manufacture of nanomachines. These molecules are being investigated because both their structure (nanocrystals, nanoshells and nanomachines) and their properties can be tailored quite precisely.

Bioconjugate chemistry thus makes good use of the differing functional properties of both biomolecules and nanomaterials, which share the same size range, for a wide range of applications such as:to produce more sensitive and specific cell markers,to generate markers of many biological processes to acquire better images,to prevent the immune system from reacting to and neutralizing targeted drug delivery systems

These benefits are due directly to the nanoscale of the structure. For instance, some nanostructures act as fluorophores or produce other optical effects in the near infrared region of the spectrum of light. In this region of the spectrum, tissues are actually transparent, and coating appropriate nanoparticles with specific biomolecules such as antibodies could potentially help image tissues or even test their function, using such light sources.

Applications of Nano Biotechnology:

Nanotechnology is helping to considerably improve, even revolutionize, many technology and industry sectors: information technology, homeland security, medicine, transportation, energy, food safety, and environmental science, among many others. Described below is a sampling of the rapidly growing list of benefits and applications of nanotechnology

There are a number of applications of nanobiotechnology in medical and clinical fields such as disease diagnosis, target specific drug delivery and molecular imaging. Such advanced applications of this approach to biological systems will transform the disease diagnosis, treatment and prevention of the disease in future. Some of the applications are discussed below:
Diagnostic applications: Current diagnostic methods for most diseases depends on the manifestation of visible symptoms. But by the time symptoms have appeared, there may be less chances for the treatment to be effective. Therefore, earlier a disease can be detected, more effective the cure is. Nanobiotechnology is expanding the currently available techniques for disease detection which will result in high sensitivity and far high efficiency. Nanobiotechnology offers a solution by providing semiconductor nanocrystals (also known as quantum dots) that allows detection of the disease by binding with disease specific targets. Nanosphere is one of the companies that developed techniques that allow doctors to optically detect the genetic compostion of biological specimen. This technique facilitate the detection of pathogenic organism and has shown promising results for the detection of various diseases.

Opportunities and challenges of nanotechnology
In a world of finite resources and ecosystem capacity, the prevailing model of economic growth, founded on ever-increasing consumption of resources and emission pollutants, cannot be sustained any longer. In this context, the "green economy" concept has offered the opportunity to change the way that society manages the interaction of the environmental and economic domains. To enable society to build and sustain a green economy, the associated concept of "green nanotechnology" aims to exploit nano-innovations in materials science and engineering to generate products and processes that are energy efficient as well as economically and environmentally sustainable. These applications are expected to impact a large range of economic sectors, such as energy production and storage, clean up-technologies, as well as construction and related infrastructure industries. These solutions may offer the opportunities to reduce pressure on raw materials trading on renewable energy, to improve power delivery systems to be more reliable, efficient and safe as well as to use unconventional water sources or nano-enabled construction products therefore providing better ecosystem and livelihood conditions.
However, the benefits of incorporating nanomaterials in green products and processes may bring challenges with them for environmental, health and safety risks, ethical and social issues, as well as uncertainty concerning market and consumer acceptance. Therefore, our aim is to examine the relationships among guiding principles for a green economy and opportunities for introducing nano-applications in this field as well as to critically analyze their practical challenges, especially related to the impact that they may have on the health and safety of workers involved in this innovative sector. These are principally due to the not fully known nanomaterial hazardous properties, as well as to the difficulties in characterizing exposure and defining emerging risks for the workforce. Interestingly, this review proposes action strategies for the assessment, management and communication of risks aimed to precautionary adopt preventive measures including formation and training of employees, collective and personal protective equipment, health surveillance programs to protect the health and safety of nano-workers. It finally underlines the importance that occupational health considerations will have on achieving an effectively sustainable development of nanotechnology

Conclusion:
The multidisciplinary field of nanobiotechnology is bringing the science of small devices closer and closer to reality. Nanobiotechnology offers wide range of uses in medicine. Drug delivery system and other such innovations are the beginning of something new. Conclusions and Future Perspectives
Nanobiotechnology, a highly topical area of great significance and perspective, deals with the control, manipulation, synthesis, and biofunctionalization of structures/devices at the nanometer scale. Various biomedical applications of nanostructures are based on their specific physicochemical and biological properties regarding size (diameter), surface (porosity), pH, solubility, complexation (binding/ligand capacity), bioavailability, toxicity, and cellular and molecular effects. Polysaccharides are the most commonly used polymers for the design of nanobiosystems, due to their widespread availability, renewability, low cost, versatility, biocompatibility, biodegradability, and lack of toxicity. Solvent evaporation or diffusion, spontaneous emulsification, self-assembly, dialysis, and hydrophobic modification are the main techniques applied for the preparation of polysaccharide-based nanobiostructures. In recent decades, interdisciplinary researches and the use of biocompatible and biodegradable natural and synthetic polymers have contributed to the rapid development of nanobiotechnology for diagnosis (imaging), drug delivery, and targeting of extremely serious disorders, such as cancer, Parkinson and Alzheimer diseases, chronic inflammations, ocular dysfunctions, and microbial/viral infections. Current research is also focused on developing modern nanosystems, including niosomes, polymeric nanoparticles, nanocomposite (colloidal) hydrogels,

polymeric micelles, dendrimers, aptamers, capsosomes, nanoneedles, molecularly imprinted polymers, stimuli-responsive polymers, therapeutic polymers (polymer–drug conjugates), and polymeric artificial cells.
Expectations from nanobiotechnology in the medical field are high and the benefits are endlessly enlisted but the safety of nanomedicines are not yet defined. Scientists who are against the use of nanotechnology also agree that advancements in nanobiotechnology should continue because this field promises great benefits. It is possible that nanomedicines would play a crucial role in the treatment of human diseases. If everything runs smoothly, nanobiotechnology will one day become an inevitable part of our life and will help saving many lives.

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