Chapter

Role of Nanobiotechnology in Drug Discovery, Development and Molecular Diagnostic

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Abstract

Nano-biotechnology has already tested its magnitude in a number of sections of existence science and biotechnology field. It is no longer hyperbole to say that in future, nano-scale method would in reality take the associated science area to the subsequent level. Since, there are technical hurdles present; despite the fact that scientists are giving their great to overcome such problems. Applications of nano-biotechnology have already been discussed in this chapter. Future potential are really associated with innovative amendment of such applications. Despite of some impedance, this technology presents giant hope in the future. It performs most important position in distinct sorts of biomedical application such as shipping of drug, gene therapy, biosensors, biomarkers and molecular imaging. It additionally leads to innovations in this field. The fundamental lookup goal of this discipline would be the innovation of early analysis approach and cure with target-specific remedy therapy. Although there would possibly be some safety worries with admire to the in vivo use of nanoparticles, research are in region to decide the nature and extent of adverse events.

Keywords: nanobiotechnology, drug discovery, drug design, nanoparticle, biosensors

1. Introduction

The effective treatment for disease requires the improvement of diagnostic method, development of optimized drug loaded formulation and incorporation of optimized formulation in to suitable delivery system in terms of role of nanotechnology in drug discovery and development.

There has been challenging task for researchers to increase analytical capacity with improved data quality, consuming less sample volume for storage and screening of cell and tissue library at molecular level. In current scenario the innovative format of nanotechnology offers advancement in the technology, overcoming the initial challenges of unreliable data, consuming high sample and various other issues [1].

Pharmaceutical industries are continually facing a challenge to find better drug discovery technologies because of availability of various competitive other medicinal market. This industry requires discovering and developing new medicines for the effective treatment of wide range of diseases likely to grow regulatory

challenges, costing revolution and various other barriers. Recently, all pharmaceutical companies giving importance to common processes including cloning and expressing human receptors and enzymes for discovering innovative drugs, that allow high throughput, automated screening and the application of combinatorial chemistries. Presently, the drug discovery industry should have massive amounts of data about life's molecular components in the area of genomics and proteomics revolution [2].

The Pharmaceutical and biotechnology firms have spent billions of dollars on novel technologies in order to improve productivity, accelerate the drug discovery and development processes and sustain market share.

Nanotechnology refers to development of innovative research and technology at the atomic, molecular and macromolecular level with controlled manipulation, and the study of structures and devices are done in the 1 to 100 nanometers range. The conclusive remark at this scale, Nanoparticle take on beneficial novel properties and functions like small size, surface tailorability, improved solubility, and multifunctionality as compared to seen in the bulk scale. This nanofield may open many new avenues of research for biologists. The novel nanotechnology using nano-materials can interact with complex biological organ consuming low level of biomolecules.

The development and design of multifunctional nanoparticle offers new opportunity for interdisciplinary researchers that can target, diagnose and treat diseases such as cancer. Within the field of discovery and development of nanomaterials, nanotechnology focuses to improve diagnostic methods, improved drug loaded delivery system for the effective and enhanced therapy. Now a days, the scientific community is paying attention on the physical, chemical and biological properties of nano-sized materials so that development of new applications can be done in order to improve human health.

Earlier the nanotechnological concepts have been discussed in 1959 by physicist Richard Feynman during his talk "There's Plenty of Room at the Bottom," describing manipulation of atom is a key to possible different method of synthesis. In 1974, Norio Taniguchi used the term "nanotechnology." The scanning tunneling microscope was invented in the year 1981, ensures the clear visibility of individual atoms and bonds. Initially the term nanotechnology was used in designing nanoscale devices studying about carbon nanotube [3]. The National Nanotechnology Initiative (NNI) defines nanotechnology as research and development of nanosized delivery system with novel functional properties. Subsequently manipulation of atoms could be possible to create efficient nanomaterials with characterized *invitro* and *invivo* parameters. Thus the inherent nanoscale functional properties to the biological tissues, proves that nanotechnology could be feasible for the application to the life sciences successfully. With growing research in the field of nanotechnology, large number of nanotechnologies using nanomaterials has been studied, but there is no study about safety and toxicity. For this purpose *in vitro* diagnostic use of nanotechnology without any safety risks to people and *in vivo* characterization of nanoparticles, ranging smaller size <50 nm in size, were studied. The smaller size of nanoparticle concerns over the entry and localization of the particles in to the cells, but there are still many unanswered questions related to huge diversity of materials used and its wide range in the sizes of nanoparticles, these effects will vary a lot. It has been conceived by many researchers that particular sizes might turn out to have toxic effects and consequently further investigation are required. The FDA approval is mandatory for clinically approval the applications of nanotechnology and substantial regulatory problems in the nanotechnology-based product. Consequently the term "nanobiotechnology," has come in to existence as a unique fusion of biotechnology and nanotechnology [4]. This article will provide an integrated overview of application of nanobiotechnology based

molecular diagnostics, drug discovery, and drug delivery in the development of nanomedicine with the relationships.

2. Nanobiotechnology

The word "Nanobiotechnology" is a combined study of "The Nanotechnology" including design, development and application of nanomaterials & devices and "The Biotechnology" including the various function of biological site like micro-organisms [4]. The field of nanobiotechnology will grow in the development and discovery of drug in upcoming scenario at exponential rate, Where atom or molecule level devices can be constructed by incorporation of drug in to suitable biocompatible delivery system. Hence nanobiotechnology can help various aspects of biological problem with the help of nanotechnology and information technology. This technology has capacity to build bridge among different branches of sciences providing newer challenges and opening new door in the field of research & diagnostics, education in the near future [5]. Relation between nanobiotechnology, bionanotechnology, and nanobiology are the terms referring to the intersection of nanotechnology and biology. Nanobiotechnology includes recent advances in nanotechnology to improve biotechnology, and bionanotechnology, which aims to have advantage of natural/biomimetic approaches to create devices with nanosize range [6].

This article will focus on the principal trends and the implications of nanobiotechnology in drug discovery, development and molecular diagnostic.

3. Advantages of nanobiotechnology

Nanoformulation based on oral and topical drug delivery in biotechnology can stimulate molecular imaging for brain tissue engineering and drug delivery through blood brain barrier, Improvement of CNS directed neuroprotection or regeneration, drug uptake assistance, showing fewer side-effects compared to conventional molecules, more active therapeutically in treating brain tumors, Successful biodistribution, High bioavailability, DNA and RNA molecules provide high affinity and binding on specific target site, devoid of enzymatic degradation enriches lymphatic

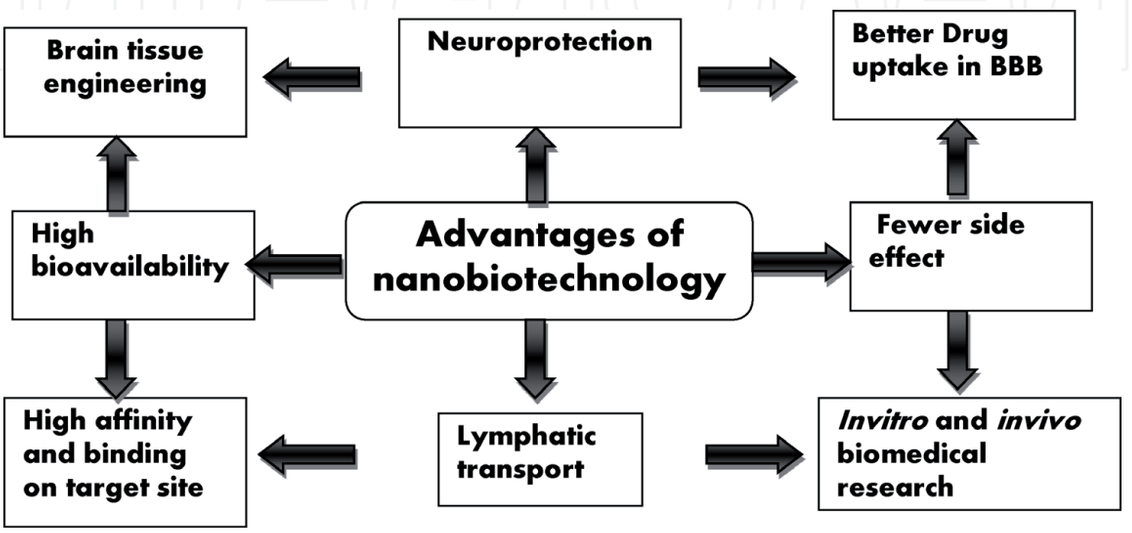

Figure 1.
Advantages of nanobiotechnology.

transport, development of biosensors, nontoxic and biodegradable nature, enhancement of the potency of anticancer drugs, in vivo and in vitro biomedical research and accomplishment of easy Drug targeting (**Figure 1**) [7–13].

4. Nanobiotechnology in drug discovery and development

The application of nanobiotechnology has an impact on diagnostics and drug delivery. Currently, researchers are starting to use nanotechnology in the field of drug discovery and development. Nanocrystals (QDs) and other nanoparticles (gold colloids, magnetic nanoparticles, nanobarcodes, nanobodies, dendrimers, fullerenes, and nanoshells) have unique advantages for the development of drug and its discovery i.e. QDs and magnetic nanoparticles are being used for barcoding of specific analytes which are key components of the bio-barcode assay, can be future alternative to the protein chain reaction [1].

The term "Nanomolecular diagnostics" is the use of nanobiotechnology at molecular level to diagnose and treat chronic diseases", extending the limits of molecular diagnostics to the nanoscale. The nanomolecular diagnostic field can meet the rigorous demands of the clinical laboratory and can be cost-effectiveness [6].

Nanoparticles have emerged as promising nanoplatforms for efficient diagnostics and therapeutics possessing characteristic properties at the nanometric scale. The feasible immobilization of specific ligands on the surface of biological site have become ideal candidates for molecularly sensitive detection, molecular imaging, and novel carriers for targeted drug and gene delivery, targeted photothermal therapy [6]. The nanoparticle in the form of nano-vesicle surrounded by a membrane or a layer holds convenient surface i.e. spherical, cylindrical, plate-like for molecular assembly of inorganic or polymeric materials and drug. The size and size distribution of nanoparticle becoming extremely critical and plays very significant role for penetration through a pore structure of a cellular membrane. The Biomarkers for occupying their distinguished color requires efficient fluorescent probes which depends upon the narrow distribution of average particle sizes. These narrow sizes particles emit a very wide range of wavelengths. The multifunctional nano particles core with several luminescent layers like magnetic nanoparticles can detect and manipulate the particles. Thus the Nanoparticles provides combine platform of biotechnology, nanotechnology and information technology facilitating molecular, biochemical and biological processes, e.g. genetics and pharmacogenomics.

The surface morphology of nanoparticles can be redesigned to reach at their target like blood brain barrier and dermal tight junctions more efficiently, overcoming the efficacy issues of drug on the physiological barriers. In case of malignant tumors Nanoparticles with leaky vasculature structure may penetrate the lesion. Nanoparticles may contain natural and synthetic polymer for coating an inorganic core of superparamagnetic materials. Some examples of nanoparticles as contrast agents in magnetic resonance for molecular diagnosis are given here [5].

4.1 Gold nanoparticles

Gold nanoparticles are the most typically used nanomaterial in diagnostics; they have many different uses as properly. They may be extensively utilized as a connecting factor and to construct biosensors to hit upon ailment DNA. Rather than a fluorescent molecule, a gold nanoparticle can be attached to an antibody and other molecules, consisting of DNA, can be brought to the nanoparticle to supply bar codes. The gold particles are very chemically reactive and make excellent catalysts at nanometer scale. Recently, gold nanostructures have found a very important

role in a wide variety of applications, including bio-imaging, drug delivery, toxic gas detection, biosensors and to demonstrate multiphoton absorption-precipitated luminescence (mail) [14].

4.2 The quantum dots for drug discovery

Quantum dots (QDs) are regarded as a unique class of fluorescent labels, with unique optical properties such as high brightness and long-term colloidal and optical stability; these are suitable for optical imaging, drug delivery and optical tracking, fluorescence immunoassay and other medicinal applications. The unique optical property of QDs allows one to investigate the real-time dynamic events in living cells and such events include interaction between intracellular proteins, the mechanisms of intracellular signal transmission and cell growth. Some benefits and downsides have been investigated more suitable optical residences compared with natural dyes like incredible imaging outcomes using organic dyes, absorption of numerous drug molecules for an extended time frame [15].

4.3 Conjugates of nanoparticles and DNA protein

Conjugation Nanoparticle-DNA protein hold great promise in biomedical applications. Many Diverse strategies have been developed to conjugate nanoparticles and DNA proteins to assemble and purify nanoparticle-protein link. First, stable and biocompatible nanoparticles are synthesized. Conjugation of the nanoparticle to the DNA protein is then achieved via two different approaches that do not require heavy chemical modifications or cloning, cysteine-gold covalent bonding, or electrostatic attachment of the nanoparticle to charged groups of the protein. Co-functionalization of the nanoparticle with PEG thiols is recommended to help protein folding. Finally, structural characterization is performed with circular dichroism, as this spectroscopy technique has proven to be effective at examining protein secondary structure in nanoparticle-protein conjugates. In general, functionalization of NPs with proteins such as antibodies can be achieved by direct chemical covalent conjugation or electrostatic interactions. The Semi-artificial conjugates of nucleic acids and proteins by both covalent coupling chemistry, or else through noncovalent biomolecular recognition systems, which include receptor-ligands of complementary nucleic acids for immunological detection assays [15].

4.4 Nanochips

The Nano Chip System by utilizing electronically enhanced hybridization of complementary DNA strands, integrates advanced microelectronics and molecular biology into a platform technology with broad commercial applications in the fields of genomic diagnostics and has achieved 100% accuracy in the detection of nanoparticle. This technique helps in investigating DNA sequences or the pairing of separated strands of DNA with complementary DNA strands of the acknowledged collection that act as probes. Currently, DNA chips is known as DNA microarray assays that employs the energy of a digital contemporary that separates DNA probes to unique web sites at the array based on charge and size, then test sample (blood) can be analyzed for identifying DNA sequences via hybridization with these probes [16].

4.5 Microfluidics (lab-on-a chip)

Microfluidics is the modern science of fluids on the nanometer scale. The nanodiagnostics involve microfluidic or "lab on a chip" structures, in which the

combination of numerous approaches of DNA analysis is mixed on an unmarried chip composed of an unmarried glass and silicon substrate. Academically, it is a subdiscipline of fluid mechanics, as the fundamental equations describing the physics of fluids at larger length scales are identical to the equations underlying microfluidics. In general, the microfluidic biosensor platforms offer numerous advantages compared with other traditional methods such as ultracentrifugation, electrophoresis, nuclear magnetic resonance, chromatographic approaches, etc. for detection of bio-species molecules. This device have capable of measuring aqueous reagent and DNA-containing answers, mixing the solutions together, amplifying or digesting the DNA to shape discrete merchandise, Destiny possibilities for the utility of nanotechnology in healthcare and for the development of personalized remedy seem like amazing [17].

5. Nanobiotechnology in designing of drug delivery system

Among the new technologies, nano-biotechnology has evoked considerable interest for application in the pharmaceutical industry. Important applications of nano-biotechnology are in the areas of drug discovery, drug development, and drug delivery, and these are collectively referred to as nano-pharmaceuticals. Nano-biotechnology, particularly the use of nanoparticles, has made significant contributions to drug discovery and development [18]. In addition to the use of nano-biotechnology for drug discovery, some drugs are being developed from nano-materials. Well-known examples of these are dendrimers, fullerenes, and nano-bodies. At present time increasing the use of nano-biotechnology in many pharmaceutical and biotechnology industries is anticipated. In case of drug development from formulate to appropriate dose to administer with optimal delivery systems, nanotechnology is being utilized at all the stages. Nano-biotechnology applications are also involving in diagnosis of diseases. In future it may be possible to computers are connected with nano-biotechnology systems and provide the appropriate and complete knowledge about complete model or an individual cell. This virtual representation might be helpful for researcher or scientist to develop novel drugs with high rate of accuracy and precision without conducting any experiment in living organisms.

The major challenges in front of drug delivery scientists are poor solubility, high molecular size and low bioavailability for clinical candidates. Other challenges in this field are pediatric and geriatric drug administration, protein and peptide drug delivery etc. Today's major demand in drug delivery field is to develop ideal, safe and effective, non-invasive drug delivery methods.

Nano-biotechnology sector play a significant role to overcome the above drug delivery problems. It provides the following solution related drug delivery problems: (a) With the help of this technology particle size of drugs is reduced in nanometer size range, it enhance the surface area and ultimately improve rate of dissolution, (b) Nano-meter size range of drug also useful to improve their solubility, (c) With the help of this technology scientists trying to develop non-invasive routes of drug administration method which can eliminates the use of injectable drugs, (d) developed nanoparticle formulations has better alternate for non-stable and lower shelf lives formulations, (e) nanotechnology based formulations improved the solubility of poorly soluble drug and enhance absorption capability, improved bioavailability and release rate of large molecules, reduced the optimum dose and enhance the safety margin by reducing the side effects, (f) Nano-biotechnology principles help in developing of Sustain and controlled release formulations with better patient compliance [19].

6. Nano-biotechnology in molecular diagnostic

Nano technology has gained enormous popularity in recent past decades. In lay man language nano technology is defined as the use of least possible input to get maximum possible output. Nano word is used in terms of size. This technology is considered as wonderful amalgamation of physics and chemistry. When this technique is applied with biology, it brings about a new field termed as Nano-biotechnology; where biochemical processes are modified to get far better results than that of simple bio technological procedures.

As far as the medical field is concerned, the harness of nano- biotechnology for diagnostic purpose is successfully obtained (**Figure 2**). It assists to develop more sensitive diagnostic kits than that of existing one. Such instruments are suitable to probe the bodily problems at cellular pores and receptor level. Moreover, it is due to tiny sized diagnostic materials the degree of toxic and adverse effects have been markedly reduced. New dimensions of diagnostic tools have been explored with the aid of this cutting edge technique. Several modifications are still under developmental phase.

6.1 Nano-particles used in the diagnosis

Gold nano-particles are also termed as metallic particles. These are produced from gold salts of either organic, aqueous or both origins. A suitable stabilizer is used to get stable particles with good ligand binding capacity. Usable size of particles is ranging between 3 and 100 nm. The major application is due to their electronic, optical, and thermal properties [20].

Magnetic nano particles are formulated from magnetic materials like Fe_3O_4, Fe_2O_3, and many other ferrites. Nanoparticles can be incorporated with bio- marker moieties so that they can be utilized to investigate various biomolecules and help in different processes like separation and purification. The involvement of surface coating materials is significant to ascertain the size and kinetics of these particles. That's why the nature of coating materials should be examined before use [21].

Quantum dots are semiconductor nano-crystals that are easy to synthesize and have characteristic properties that are between those of bulk semiconductor and discrete molecules. Their diameter ranges from 2 to 10 nm. Their fluorescent property relies on size of the quantum dot [22].

Carbon nano tubes are composed of graphite. On the basis of number of graphite, these nano tubes are categorized into two classes- tubes with only one layer of graphite

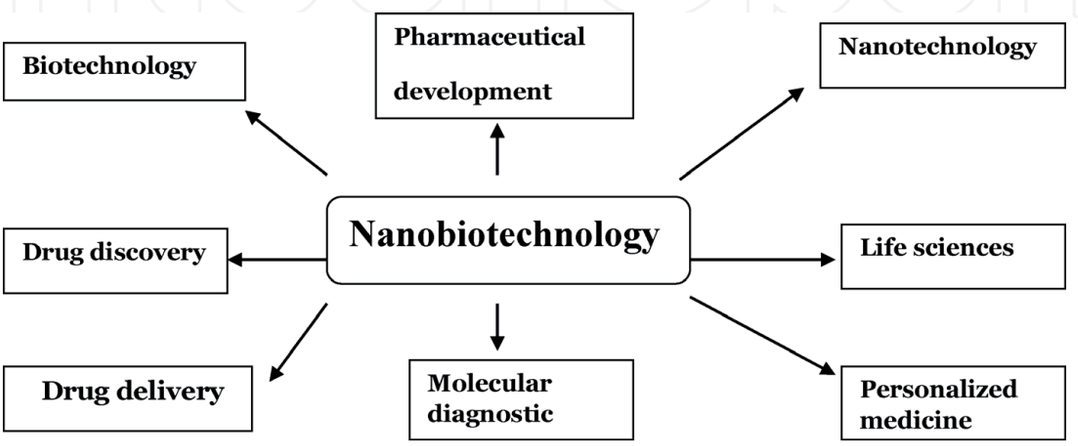

Figure 2.
Application of nanobiotechnology for molecular diagnosis.

are known as mono walled carbon nano tubes on the other hand, tubes consist of multiple layers of graphite are termed as multi walled carbon nano tubes. The main advantage of such tubes is that they can conduct high electricity with less or no heating effect. This happens because of scattering free traveling of electrons throughout the tube [23].

Liposomes are spherical vesicles where an aqueous core is surrounded by a phospholipid bilayer and cholesterol. The phospholipid consists of a hydrophilic head and two oil-loving tails. The phospholipid that is predominantly used is phosphatidyl choline [24].

Dendrimers are the emerging and well defined polymeric architectures that are known for their large, complex and well defined structures, versatility in drug delivery and high functionality whose properties resemble with biomolecules. These nanostructured macromolecules have potential abilities to entrap and to conjugate the high molecular weight hydrophilic/hydrophobic drugs by host-guest interactions and covalent bonding (prodrug approach) around an inner core respectively. They have different Features like size, shape, branching length, and their surface functionality vary over the design of nanoparticles. For example, Polyamidoamine are usually used dendrimers [25].

Nano bio sensors are applied to investigate biochemical changes with the aid of electronic, optical or magnetic technology. Furthermore, detection and/or quantification of bio molecules like specific base pairs or proteins are also possible. Majority of biosensors work on the principle of key and lock theory or affinity based mechanism; where immobilized tool attaches to target molecule/analyte being sensed in this phenomenon, any change at a localized surface can be examined rather than detecting target in solution. This variation can be sensed by using one of the following methods; viral biosensors, light sensitive biosensors, resonant cantilever and quartz crystal microbalance [26].

6.2 Nanotechnology used in diagnosis

6.2.1 Nanotechnology-based biochips/microarrays

A nano material can be perfectly examined by using same sized probe. This hypothesis is applied in molecular diagnosis with the help of biochips or microarrays. This is because the cell organelles/biological moieties exist in nano size and the biochips also falls under in almost similar tiny sized scale. Nano fluidic arrays and protein nano biochips are the examples of nanotechnology based biochips. These chips are capable to isolate and analyze living cell molecules such as genetic material DNA. In future this technique will certainly bring about revived investigation tool for cancer. Nano-fluidic technology is expected to have broad applications in systems biology, personalized medicine, pathogen detection, drug development, and clinical research [27].

6.2.2 Nanotechnology-based cytogenetic

Cytogenetic has been used mainly to elaborate spatial arrangement of the chromosome and screening of abnormalities related to disease. The use of fluorescent in situ hybridization (FISH) is now reaching its limit. Molecular cyto-genetics is now enhanced by use of biomedical nanotechnology, e.g., use of atomic force microscopy (AFM) and quantum dot (QD) FISH [28].

6.2.3 Nano-proteomic-based diagnostics

A comprehensive study including identification, characterization and analysis of a series of bio protein at a specified time is known as proteomics. Proteomics help to recognize the variations which are associated with various pathological conditions.

These variations are identified on the basis of spatio-temporal position of protein molecules. A small change in molecular level can bring about such variations as a consequence proteome may be altered; which are further quantified for clinical diagnosis. Gel- based and gel- free are the common proteomics techniques, which work on separation, observation, analysis and marking the altered proteome [29].

6.2.4 Nanoparticle-based nucleic acid diagnostics

Screening of pathogenic microorganism on the basis of genomic arrangement has become relevant in current clinical determination. It has been well established central dogma of life that each and every living organism has a peculiar set of DNA, which has been transferred from one generation to next without any sort of alteration; this can also be said to be the individualization by nature. In clinical diagnosis, this DNA fragment may help to check the availability of the microorganism in the test sample. This investigation opens the door for molecular detection. This is carried out by using polymerase chain reaction (PCR) or hybridization techniques, known as amplification method and non-amplification method respectively. Therefore, this technique is considered to be more sensitive and precise than that of other techniques [30].

6.2.5 Nano-bio-sensors

Bio sensors are sophisticated probes, which are used to investigate the existence and/or concentration of a biological analyte, say for example bio molecule, histology of biological material or any microorganism. Biosensors comprise of following parts: amplifier that detects the analyte and generate a signal along with it a signal transducer that converts the signal into electric impulses and a reader to record and investigate the signal [31].

7. Safety issues of nanoparticles

Nano-biotechnology is the fine amalgamation of multi disciplines of science. In pharmaceutical field, the scientists and researchers are trying to overcome the demerits of existing drug molecules with the aid of this wonderful technology. There are many expected potential benefits in bank. In spite of that safety is the main concern with the in- vivo application of nano engineered medicines yet.

It has been revealed that while production or use of nano medicines, such particles can easily get inside the human body and ultimately blood stream and then in various vital organs; where they exert unintended adverse effects, sometimes these effects are fetal for the user.

An in- vivo study on monkeys and rats have disclosed the aggregation of carbon and manganese nano materials in the olfactory bulb, which has produced severe pathological consequences pertaining to nervous and respiratory system.

Several animal studies have shown such sort of abnormal pathological disturbances.

In order to combat with this problem firstly, an efficient probe will have to develop for thorough assessment of risk associated with the use of nano medicine. Second and the most significant challenge would be to develop authentic validation protocol for testing nano medicines in animals so as to get the data of toxic effects in early stage of testing. A restructured, compact and integrated regulatory approach is much needed to look into the expected risks for delivering the promising and safe medicines [2].

8. Regulatory perspective of nanobiotechnology

In the event that we talk about the most recent decade, nano bio-innovation has generated some new impedance for the research community, industry, and regulators. Applicable techniques have some loopholes regarding fabrication and processing of nano medicines, that's why special provisions would be required to tide-over such complications [32]. FDA and other regulatory authorities experience many unavoidable consequences for the release of such products. This is due to non-authentic validation program in clinical trial phase [11]. A wing of researchers proposes sturdy contentions, revealing both positive and negative aspects pertaining to the advancement of nano-materials. They suggest that vague protocol throttle research and product development, which represses the development and viability of new nano-medicines. Apart from that, a robust administrative body is made so as to push the business advancement by creating certainty for pharmaceutical firms and trust within the ultimate consumers [33]. Currently, the FDA, EMA (European medical agency), and other regulatory agencies examine each new nanoparticle individually. There is commonly an absence of benchmarks in the assessment of nano-medicines as a unique class of therapeutic agent [34]. Afterwards, administrative corporations might imagine of a complete listing of screening and a powerful approbate system that enclose the complete variety of particle characterization, pharmacology, and toxicology troubles.

9. Future prospects

In case we consider in trendy approximately the two major capabilities of nanobiotechnology, first is imaging and diagnostics (quantum dots) and second are proteomics. In proteomics especially study and detect about nucleic acids and proteins [35]. Currently, the Thermal Sensitive drug delivery system has been developed for the treatment of cancer. In this, drug is given in the injection form, which reaches inside the body and converts into insoluble form and accumulates in the tumor cells because the temperature of the tumor cell is more than the normal cell [36]. In spite of the tremendous credibility of nanobiotechology, its use has been considerable due to its toxicity and environmental problems. Despite all this, the drug delivery, drug discovery, gene therapy, molecular imaging, biomarkers, and biosensors fields are exploring possibilities in the nanobiotechnology. Nanobiotechnology has brought a bright future for the clinical diagnosis and targeted drug delivery sector. Now in the field of diagnosis, it has become easier to detect diseased cells rapidly, due to which it is possible to prevent diseased cells from spreading in the body [37]. There is a constant development in this field right now and it is possible that some incurable diseases in the future will actually be cured with the resources of nanobiotechnology.

10. Conclusion

Nano-biotechnology is in its primary stage in terms of development. Due to continuous innovative research and abundant use, nano-biotechnology is having a wide impact on the fields of science and technology. Nano-biotechnology is presenting some unique possibilities in medicine, diagnosis and biomedical sciences. The innovation of nano-biotechnology in drug delivery systems has led to the introduction of something new, and with the help of this, it seems possible to treat some incurable diseases. Although the potential for benefits from nano-biotechnology is high, the prospective of nanomedicine is not fully defined. In fact, regulatory

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bodies do not have appropriate guidelines that balance its risk and safety factors. It would be fair to say that in future nano-biotechnology will play an excellent and unique role in the treatment of human diseases and the study of human physiology. From the research conducted in nano-biotechnology in the last few years, it can be inferred that in future, nano-biotechnology will become an indispensable phase of our daily life.

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References

[1] Jain KK. Nanodiagnostics: Application of nanotechnology in molecular diagnostics. Expert Review of Molecular Diagnostics. 2003;**4**:153-161

[2] Elder A, Gelein R, Silva V, Feikert T, Opanashuk L, Carter J. Translocation of inhaled ultrafine manganese oxide particles to the central nervous system. Environmental Health Perspectives. 2006;**114**:1172-1178

[3] Shamshad S, Indira PA. Nanobiotechnology - A new era in science. New Horizons in Biotechnology. 2015;1:208-212

[4] Jain KK. The role of nanobiotechnology in drug discovery. Drug Discovery Today. 2010;**10**(21):1435-1442

[5] Salata OV. Applications of nanoparticles in biology and medicine. Journal of Nanobiotechnology. 2004;**2**:3

[6] Kawadkar J, Chauhan MK, Maharana M. Nanobiotechnology: Application of nanotechnology in diagnosis, drug discovery and drug development. Asian Journal of Pharmaceutical and Clinical Research. 2011;**4**:23-28

[7] Nair SB, Dileep A, Rajanikant GK. Nanotechnology Based Diagnostic and Therapeutic Strategies for Neuroscience with Special Emphasis on Ischemic Stroke. National Institute of Technology Calicut: India; 2011

[8] Sadrieh N, Tyner KM. Nanotechnology and therapeutic delivery: A drug regulation perspective. Therapeutic Delivery. 2010;**1**(1):83-89

[9] Allen TM, Cullis PR. Drug delivery systems: Entering the mainstream. Science. 2004;**303**:1818-1822

[10] Vasir JK, Labhasetwar V. Targeted drug delivery in cancer therapy. Technology in Cancer Research & Treatment. 2005;**4**:363-374

[11] Vasir JK, Reddy MK, Labhasetwar V. Nanosystems in drug targeting: Opportunities and challenges. Current Nanoscience. 2005;**1**:47-64

[12] Feng SS, Mu L, Win KY, Huang G. Nanoparticles of biodegradable polymers for clinical administration of paclitaxel. Current Medicinal Chemistry. 2004;**11**:413-424

[13] Alyautdin RN et al. Significant entry of tubocurarine into the brain of rats by adsorption to polysorbate 80-coated polybutylcyanoacrylate nanoparticles: An in situ brain perfusion study. Journal of Microencapsulation. 1998;**15**:67-74

[14] Ralph AS, Pilar RG, Feng Z, Marco Z, Wolfgang JP. Biological applications of gold nanoparticles. Chemical Society Reviews. 2008;**37**:1896-1908

[15] Niemeyer CM. Semi-synthetic nucleic acid-protein conjugates: Applications in life sciences and nanobiotechnology. Journal of Biotechnology. 2001;**82**(1):47-66

[16] Estes R. Semiconductor packaging technologies advance DNA analysis systems. IVD Technology. 2005;**4**:1-5

[17] O'Connor L. Nanotechnology advances. BioScience. 2005;**4**:1-5

[18] Jain KK. Role of nanobiotechnology in drug discovery. Advances in Experimental Medicine and Biology. 2009c;**655**:37-43

[19] Kumari A, Yadav SK, Yadav SC. Biodegradable polymeric nanoparticles based drug delivery systems. Colloids

and Surfaces B: Biointerfaces. 2010;**75**:1-18

[20] Theron J, Cloete TE, Kwaadsteniet MD. Molecular techniques for determining microbial diversity and community structure in natural environments. Critical Reviews in Microbiology. 2010;**36**:318-339

[21] Gupta AK, Gupta M. Synthesis and surface engineering of iron oxide nanoparticles for biomedical applications. Biomaterials. 2005;**26**:3995-4021

[22] Alivisatos AP. Semiconductor clusters, nanocrystals, and quantum dots. Science. 1996;**271**:933-937

[23] Seetharamappa J, Yellappa S, D'Souza F. Carbon nanotubes next generation of electronic materials. Electrochemical Society Interface. 2006;**15**:23-26

[24] Lasic DD, Lipowsky R, Sackmann E. Structure and dynamics of membranes. Handbook of Biological Physics. 1995;**1**:493-516

[25] Svenson S, Tomalia DA. Dendrimers in biomedical applications - Reflections on the field. Advanced Drug Delivery Reviews. 2005;**57**:2106-2129

[26] Prasad S. Nanobiosensors: The future for diagnosis of disease. Nanobiosensors in Disease Diagnosis. 2014;**3**:1-10

[27] Rajasundari K, Ilamurugu K. Nanotechnology and its applications in medical diagnosis. Journal of Basic and Applied Chemistry. 2011;**1**(2):26-32

[28] Stanley M. Nanodiagnostics: A revolution in biomedical nanotechnology. MOJ Proteomics & Bioinformatics. 2016;**3**(2):34-36

[29] Ahmad Y, Arya A, Gangwar A, Paul S, Bhargava K. Proteomics in diagnosis: Past, present and future. Journal of Proteomics & Genomics. 2014;**1**(1):103

[30] Jamdagni P, Khatri P, Rana JS. Nanoparticles based DNA conjugates for detection of pathogenic microorganisms. International Nano Letters. 2016;**6**:139-146

[31] Alejandro C, Arben M. Nanobiosensors in diagnostics. Nano. 2016;**3**(10):1177

[32] Emerich DF, Thanos CG. Nanotechnology and medicine. Expert Opinion on Biological Therapy. 2003;**3**:655-663

[33] Shaffer C. Nanomedicine transforms drug delivery. Drug Discovery Today. 2005;**10**:1581-1582

[34] Desai N. Challenges in development of nanoparticle-based therapeutics. The AAPS Journal. 2012;**14**(2):282-300

[35] Hamad-Schifferli K et al. Remote electronic control of DNA hybridization throughinductive coupling to an attached metal nanocrystal antenna. Nature. 2002;**415**:152-155

[36] Meyer DE, Shin BC, Kong GA, Dewhirst MW, Chilkoti A. Drug targeting using thermallyresponsive polymers and local hyperthermia. Journal of Controlled Release. 2001;**74**(1-3):213-224

[37] Fakruddin MD, Afroz H, Hossain Z. Prospects and applications of nanobiotechnology: A medical perspective. Journal of Nanbiotechnology. 2012;**10**(31):1-8