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Nano-Biotechnology: Current Applications and Future Scope

Manam Walait[1]*, Huda Rehman Mir[1], Tayyaba Noor[1], Khadija Rani[1], Javaria Aslam[1], Komal Khalid[1], Zahra Azhar[1], Maria Saeed[1], Khadija Anwar[1], and Muhammad Naeem Akhtar[2]

[1]Department of Biotechnology, Faculty of Science & Technology, University of Central Punjab, Lahore, Pakistan

[2]Pesticide Quality Control Laboratory Multan, Pakistan

[*]Corresponding e-mail: manam.walait@ucp.edu.pk

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ABSTRACT

Background: *Nano-biotechnology pertains to biologically driven frameworks and evolution for developing wares at the Nanoscale. We explored Nano-biotechnology in this article, which is a unique multidisciplinary line of research based on the joint endeavor of biologists, chemists, physicists, engineers, and medical specialists. Different principles used in Nano-biotechnology include the electron pair combination, electron pair bond polymerization, individual organization, and self-convocation.* ***Objectives:*** *The invention of Nanoparticles has revolutionized this field. Nano-particles are of various types such as carbon-based Nanoparticles, polymeric, ceramic, and metallic Nano-particles. They are synthesized through specific techniques which comprise bottom-up and top-down methods. These Nanoparticles are useful in various processes like in stalking of stem cells, gene delivery, and drug delivery as well as in environmental remediation.* ***Methods:*** *Nano-biotechnology has diversified applications in bio-formulations, Nanofabrication, biomimetics, and the production of fuel and energy. The development of Nano-robots is another marvelous achievement of Nano-biotechnology.* ***Results****: Nano-biotechnology has also conquered the field of medical science through its prominent hallmarks in cancer diagnostics, drug delivery, gene delivery, and stem cell-based therapy.* ***Conclusions:*** *This article also focuses on the latest advancements and the future*

prospectus of Nano-biotechnology. However, there are certain limitations and challenges in this field that could not be rejected but scientists are working to bring improvements and innovations to this burgeoning field.

Keywords: Principles, Nano-particles, Applications, Therapeutics, Advancements, Challenges

INTRODUCTION

Late in the 20th century, nanotechnology and bio-nanotechnology are completely new notions, and biotechnology has been only over several generations, their ambit is still being specified [1]. Biotechnology combines scientific tools and expertise to manipulate, cellular molecular, and genetic phenomena to build up goods or commodities that are exploited in a multitude of industries extending from medicine to agriculture [2]. Bio-nanotechnology is nanotechnology's subfield that incorporates its engineering and manufacturing at the atom-level that is influenced by biological antecedents. It is likewise directly connected to biotechnology, but it incorporates the potential of designing and altering the atomic-level intricacies of the entities generated. Bio Nano equipment is developed to the atomic scale, and accomplish 3D molecular task clearly, or in the broadest terms, including procedures for individual control integrated with their framework [1].

Nanotechnology can be delineated as an innovation that permits the tunable initiation of Nano-materials while also their implementation [3]. I.e. impacting or just seeing them for their desired use, and thus tapering many pathways of biological sciences by clamping digital technology's applications and nanotechnology is embedded in mainstream biological matters [4]. It also has the capability in making a clear distinction between biology, physics, and chemistry, as well as modify our existing notions and cognition [5].

Up a different tremendous provision in consumption of that nanoparticles as Nano-containers used for key targeted techniques is the loading capability of biopolymer nanoparticles [6]. The evolution of nanotechnology in all domains is predicated on freshly spawned nanomaterials that, due to their peculiar attributes, dominate all domains. In domains such as medication delivery, diagnostics, aesthetic agents, tissue engineering, and agriculture, the merging of biological topics with nanoparticles is crucial [7]. The pharmaceutical and biotechnology sectors are encouraged to adopt Nano biotechnology more frequently. Nanotechnology will be used all through the pharmaceutical design process, from formulations for efficient absorption to detecting uses in drug testing trials [8].

Nanotechnology is utterly varied, fluctuating from addendum of traditional gadget physics to entirely new approaches relying on molecular self-build, from creating innovative stuff along with Nano-scale acreage to exploring by directly manipulating obstacles at the atomic level. This concept entails the use of scientific disciplines as divergent as organic chemistry, cell genetics, semiconductor physics, microfabrication, and surface science [9].

History

In 1857, Michael Faraday researched the creation or attributes of colloidal suspensions of "Ruby" gold particle. Their distinctive electrical and visual strengths classify them among the most captivating nanoparticles. Under appropriate illumination scenarios, Faraday illustrated how gold nanoparticles form multiple-colored fluids [10]. The notion of nanotechnology was firstly advocated by Richard Feynman, a physicist at Caltech, in 1959, gave a

presentation dubbed "There's Plenty of Room at the Bottom." As he never used the term "nanotechnology," Feynman intimated it will be able to control atoms and molecules effectively in the future [11].

Since Feynman's early theories or notions, there has been a progression in nanotechnology till 1981, when Gerd Binnig and Heinrich Rohrer physicists framed a modified form of microscope, the Scanning Tunneling Microscope, at IBM Zurich Research Laboratory (STM) [12]. Robert Curl, Harold Kroto, and Richard Smalley 1985 established that carbon may persist to highly reliable spheres recognized as fullerenes or buckyballs [13]. A few decades previously, Don Eigler of IBM Alma den and his teammates in 1990, 35 single xenon atoms on a nickel sheet were mitigated using an STM. Establishing IBM logos letters, as shown in figure 1 [14].

A few decades previously Iijima 1991, exploited Transmission Electron Microscopy to reveal vacant graphitic tubes or carbon nanotubes, which constitute other fullerene family species [15]. In 2004, accidentally discovered the latest category of carbon nanomaterial dubbed C-dots length of less than 10 nm while the single-walled carbon nanotube purification [16]. Nucleic acids are amongst the most useful aspects of nanotechnology in molecular biology. Paul Rosemond constructed "scaffolder DNA origami" in 2006 by increasing the overall enhancement and scale of self-build nanostructures of DNA in a “one-pot" process [17].

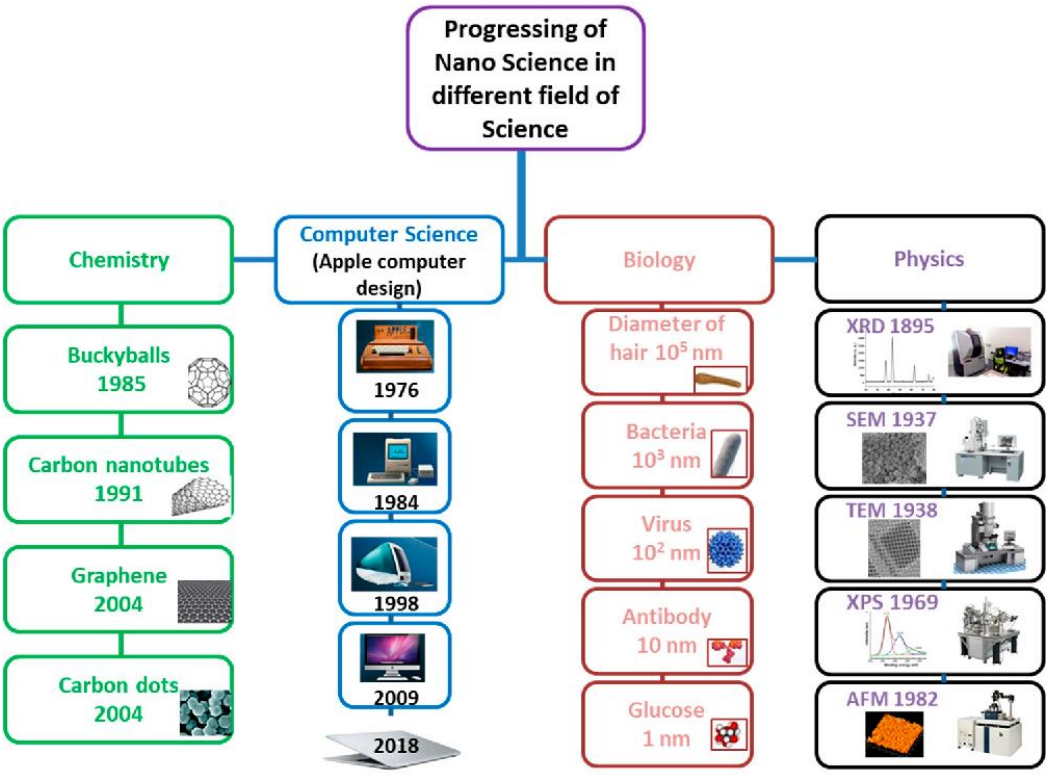

Figure 1 This diagram shows the flow chart of the history of Nano biotechnology

A multitude of contemporary studies has underscored the immense nanotechnologies' potential in medicine for the monitoring or diagnosis of many human afflictions [18]. Substantial improvements have also been accomplished in the domain of Nano-tumor, which has strengthened classical chemotherapy’s potency medications for a multitude of invasive human tumors [19]. To circumvent such in situ obstacles, Nano informatics has given a substantial auxiliary forum for nanoparticle establishment and interpretation. Nano informatics is only engaged with the

capturing, transmission, scheduling, mapping, and interpretation of crucial nanoscale level information and data. Nano informatics also aids chemotherapy by increasing the Nano-modeling of tumor cells and renders it easier to detect drug-resistant cancers. The foremost effective Nano informatics methodologies for cancer prevention with the minimum amount of detrimental direction include hyperthermia-based targeted medication delivery and gene therapy localized [20].

LITERATURE REVIEW

Principle of Nanobiotechnology

The principle of Nanobiotechnology is molecules diverse in appearance within a part aberrant mold. We made plastic, metal, or glass in any shape. The structure of our small machinery will be enclosed by the below guideline. Molecules bent exclusive distant paths to decide the place of formaldehyde arrangements. Accurate balance of small scale. Our first intention in Nanobiotechnology is to drum up the active small structure.

A Gradable Policy Agrees on Establishment of Small Machines

Four methods for the amplification of small structures by George Whiteside.

1. The first method is progressively electron pair combination. Molecules are immediately attached to electron pair atoms of applicable form. A combination of atoms namely vitamin B_{12} and Taxol along next a few hundred molecules present more elevated bound atoms. Nowadays beneficial man-made mortality. The result is planned and formerly elemental located simultaneously to develop arrangements. Molecules could be incorporated closely into any kind of compound containing an extremely affected form and an inconceivable composite of molecules.
2. The second method is electron pair bond polymerizable. Arrangements are assembled of the transferable entity that is related to an extended or radiated bond. Examples are polyethylene. Polymerization restrained only the pathway in the interval dissimilar bond accomplishing. Integrate synthetic DNA by the method of compart sides. Examples are DNA combinations in the cell. Extraordinary huge covalence particles are possibly given away by electron pair bond polymerizing. Although it has heritage bound.
    - First one is a project of synthetically connecting specific terms of monomers. A bounded connection like classes of connection
    - The second one is bounded composite to monomers like balanced beneath response keeping. Certain applicable alcohol companies are allowed inordinately adaptable for usage.
3. The third method is individual organizing. Transferable entities are also used. However small structures are shaped across a noncovalent federation of items. Every day contained specific translucent suited mechanization demonstrations. Micelles and bilayers are developed by lipoids. Individual organization atoms maintain a configuration close to quantum mechanical least possible. Discover elegant amalgamation of dealings among monetary however constantly division electron pair bond linkage among oneself. In individual organization configuration, planners need to conclude the smallest constantly hardly emplacement molecule in position devotion.

4. The fourth method of self-convocation by Whiteside is circumscribed. Self-convocation is like institute convocation of atoms about ordered, reliable and Nano covalently merged assemblage.

Two processes is self-convocation

- Polypeptide flunking
- Typical impression of self-convocation

One and the other procedure connect experimentally of several feasible corroborate before the thermostatic smallest establish [1].

Organic Equipment Metal Protein Configuration and Cohesion

Bionanotechnology is the main carbon copy. The configuration and furnishing of fundamental atoms are possibly accepted near exploiting a piece of artlessly observational information. Like as prevalent near amount ropes. However, it is acceptable as a dominant effort considering appearance or balance.

Two processes are the first one is electron-pair bond relationship compounds molecules to one alternative reliable exclusive dimensional and the second one is many classes nonrelation ship effort force communication inside atoms or joining of atoms [1].

Nanoparticles

Nanoparticles (NP) are a broad class of materials that include particulate components with a minimum size of 100 nanometers. These materials can range from 1D to 3D in shape, depending on their shape. NPs are three-layered molecules, consisting of a) The surface layer, which can be structured with a range of metal ions, surfactants, and polymers; and b) The inner layer, which can be structured with a variety of metal ions, surfactants, and polymers. c) The shell layer, which is chemically and structurally distinct from the core substance (Figure 2) [21].

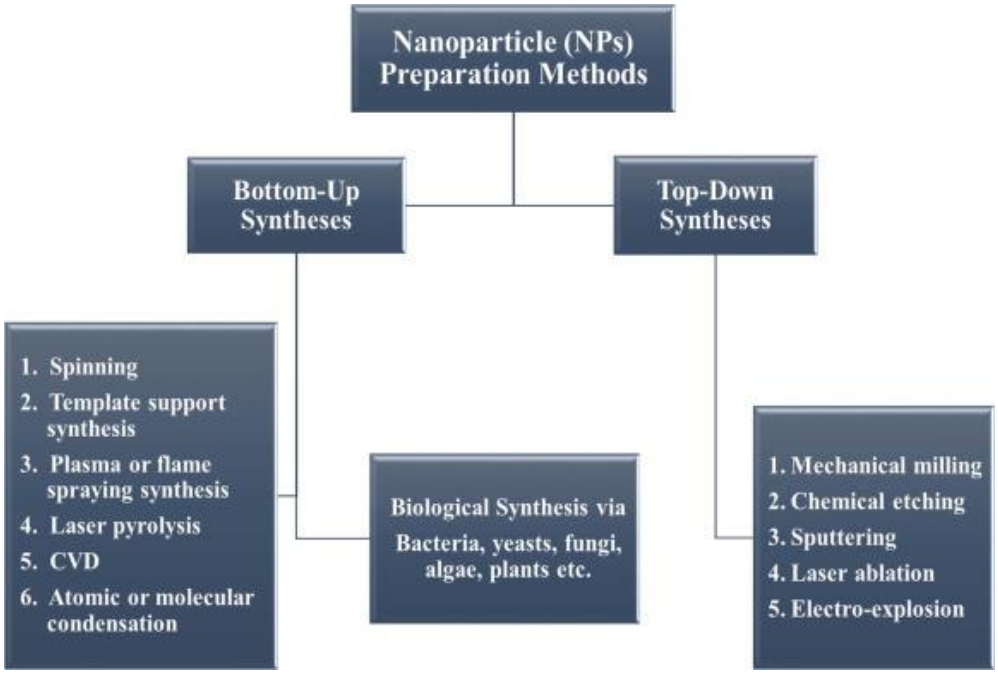

Figure 2 Typical synthesis methods for Nanoscale Particles (NPs)

Classification of NPs

Depending on their morphology, size, and chemical properties, NPs are divided into several categories. Some of the more popular NP classes are listed below based on their physical and chemical properties:

Carbon-based NPs: Carbon-based NPs are divided into 2 categories: Fullerenes and Carbon Nanotubes (CNTs). Fullerenes are chemical elements of carbon whose molecules are created of carbon atoms certain along by single and also double bonds to make an in-depth or partly blocked network of compact rings. A molecule could potentially have the shape of a tube, a spheroid, or a variety of other sorts of shapes and sizes. Carbon nanotubes (CNTs) are carbon tubes, typically measuring nanometers in diameter. Carbon nanotubes typically discuss with Single-Walled Carbon Nanotubes (SWCNT) with diameters within the range of one nanometer. Single-walled carbon nanotubes belong to the allotrope of carbon, which is an intermediate stage between carbon cages and planar graphene [22].

Polymeric nanoparticles: Polymeric Nanoparticles (NPs) are particles whose size is between one and thousand nm and can be charged with active compounds that are enclosed in the polymer core or adsorbed on the surface. Polymeric Nanoparticles (NPs) show great potential in targeted drug delivery to treat various diseases. Because of their small size, polymer Nanoparticles (NPs) have sparked a lot of attention in recent years [23].

Metal particles: It is made from metal precursors. Chemical, electrochemical, and photochemical methods are used to make these nanoparticles. These have high surface energy and the capacity to adsorb tiny molecules. These nanoparticles are employed in biomedical research, biomolecule detection and imaging, and environmental and bioanalytical applications. Before being studied in the SEM, gold nanoparticles are utilized to coat the sample. This is frequently done to increase electronic flow, which aids in the production of high-quality SEM images [24].

Ceramic nanoparticles: Ceramic nanoparticles are referred to as metalloid solid. Ceramic nanoparticles are synthesized by successive heating or cooling. Ceramic nanoparticles can be amorphous, poly-crystalline, solid, hollowed, or nonporous. The research worker concentrates on these nanoparticles because of their wide applications in dye photodegradation, photocatalysis, chemical process, and imaging applications [25].

Synthesis of Nanoparticles

Specific synthesis tactics are hired to supply the diverse nanoparticles, coatings, dispersions, or composites. Defined manufacturing and response situations are important in acquiring such size-structured particle functions. Chemical composition, particle size, crystallinity, and shape can be controlled with pH, concentration, temperature, soil adjustments, chemical composition, and engineering control. Two primary strategies are used to supply nanoparticles, top-down and bottom-up. In general, the top-down period here refers to the mechanical grinding of the storage tissue by grinding techniques. The bottom-up strategy is to build the system through chemical and self-conference tactics. The choice of the respective technique relies upon the chemical composition and the favored functions exact for the nanoparticles [26].

Uses of Nanoparticles

Nanoparticles could be used in different applications. Some of these important uses are mentioned below:

In renewable energy and environmental remediation: Nanoparticles are found in nature and have been found to heal the environment in some cases. For more than a decade, environmental restoration using nanoparticles or Nano-treatment has been successfully used to treat or purify the air, water, and soil. Surface water is treated with nanoparticles for disinfectant, filtration, and evaporation. The primary function of nanoparticles is to prevent sludge formation in home and industrial waste.

In biology: NPs used in the generation of fluorescent biological markers. NPs are used in gene delivery systems in gene therapy. NPs used for the detection of pathogens and in tissue engineering. NPs have also been used in drug delivery systems and protein detection.

In Medicine: Delivery of drugs to tumors using nanoparticles in polymer micelles. To break down bacterial clusters, polymer-coated iron oxide nanoparticles are utilized, making them a more effective treatment for chronic bacterial infections. The ability of proteins-filled nanoparticles to stimulate an immune response is affected by changing the surface of the nanoparticles. Inhalable vaccinations could be made with these nanoparticles. Celia nanoparticles act as antioxidants that remove the oxygen scavengers present in the patient's bloodstream as a result of trauma.

Applications of Nanobiotechnology

Nano-biotechnology in bio formulation: Nanobiotechnology in bio formulations covers the constraints that are associated with the commercialization of bio-inoculant formulations and large-scale development. Moreover, it emphasizes efficient bio inoculants that have a longer shelf life and recent competence against several phytopathogens and has secondary metabolite formulations.

Bio-formulation is the development of bio-pesticides and bio-fertilizers coupled with Nanobiotechnology [27].

Biomimetic: Principles of underlying mechanisms, to apply the concepts that may have benefits in medicines, science or engineering [28]. Biomimetic discovered new technologies by some biological solutions. Some of the biomimetic processes have been use for years. For example artificial synthesis of certain antibodies and vitamins. Recently biomimetics has been suggested in signal amplifiers, data converters or machine hearing systems. Some other possible applications of biomimetics include artificial organs, different electronic devices, Nano-robot antibodies etc. It is the examination of nature, its processes, and models to take inspiration from in order to solve human problems. It is the study of natural phenomena and nature in order to gain ideas from nature [29].

Nanofabrication: It is defined as the design process of devices and nanomaterials that are measured in nanometers. It is a cost-effective method because of it a large-scale economy is developed using the same machinery and a small amount of material. It uses technology state-of-the-art and it is used to manufacture microcontrollers, microchips, and various silicon chips [30].

Nanobiotechnology for energy and fuels: The world is focusing to develop alternative modes of energy production instead of using fossil fuels. The main reason behind this is that fossil fuels are exhausted and the emission of their products can cause several damages to the environment so nanotechnology can play an essential role in biofuel production and sustainable bioenergy. Different types of nanomaterials example Nano-fiber, Nano-sheets, and metal

nanoparticles have several applications in the production of biofuels [31]. Biofuels have many benefits such as renewability, sustainability, etc. and they have gathered considerable attention [32].

Nanorobots: Nano-biotechnology has also introduced new dimensions in robotics, Nano-bots will be used for introduction to the human body. Nano-robots can perform intracellular surgery etc. Different functions for example diagnosis, pathology, and correction or removal of lesions all can be coordinated by an onboard computer [33]. They are recently in the development and research phase, but they can perform their specific task at the molecular and cellular levels. Nano-robots are also known as Nano-mites, Nano-machines, and Nano-ids [34].

Nano-robots are recently disturbing the biomedicine sector, with their developments in drug delivery and cancer diagnosis [35].

Application of Nanotechnology in Neurodegenerative Indisposition based on Stem-Cell Therapy

Neurodegenerative Indisposition (NI) is marked by the developing loss of a neuron's structure or functions, resulting in the degeneration of selected neurons in the central nervous system (CNS). For patients their families and the whole society, Neurological diseases have severe commercial and societal impacts. No treatments are available for neurodegenerative indisposition and, the recent utilization of medicines can only minimize the manifestation or lag down the headway of the indisposition.

A victorious blueprint of remedial treatment for patient inhabitants needs vigilant deliberation. To cover both the disease aspects and clinical requirements they necessitate an alliance between clinicians, bioengineers, and neuroscientists [36].

In a variety of Neural diseases or brain injuries stem cells have a great perspective inducing neuroprotection. Cell remedial treatment for CNS consists of cell injection into injured brain tissue to salvage a loss of neuron function. In stroke, spinal muscular atrophy and Alzheimer's Disease (AD), Huntington's disease, Parkinson's disease, and Amyotrophic Lateral Sclerosis (ALS), there are disclose of the remunerative consequence of stem-cell transplantation on the heave of sensory-motor and cognitive functions. Nanotechnology has the aptitude to amalgamate with the stem-cell method of healing and revamp the effectiveness of the cell-based cure. In stem cells, Nanoparticles and nanomaterials can work alongside pro-neurogenic factors. Intriguingly, super-paramagnetic (NPs) can be injected into injured areas NPs (Nanoparticles) labeled with functional peptides [37].

Stem Cells and their Therapeutic Significance

Constructed on the differentiation aptitude, stem cells are designated into three types

- Totipotent stem cells (can make both fetus and placenta and have the capability to differentiate into all cell categories of a living body).
- Pluripotent stem cells (can originate only from the fetus and not the placenta and have the capability to metamorphose into all kinds of cells).
- Multipotent stem cells (can be metamorphosed into some restricted varieties of a cell).

The genesis of the Unhatched (Embryonic) stem cells (ESC) is within the blastocyst's intramural mass and they deliberated over pluripotent, while Mesenchymal Stem Cells (MSCs) are restrained by the adult tissues, which are

competent to metamorphose toward the mesodermal lineage (i.e., osteoblasts, adipocytes, and chondrocytes) as shown in Figure 3.

The transplanted MSCs are because of the propensity of migration to deterioration or inflamed tissues that have regenerative prospects. They have been corroborated as efficacious in invigorating the structural and functional regeneration of numerous tissues [36, 38].

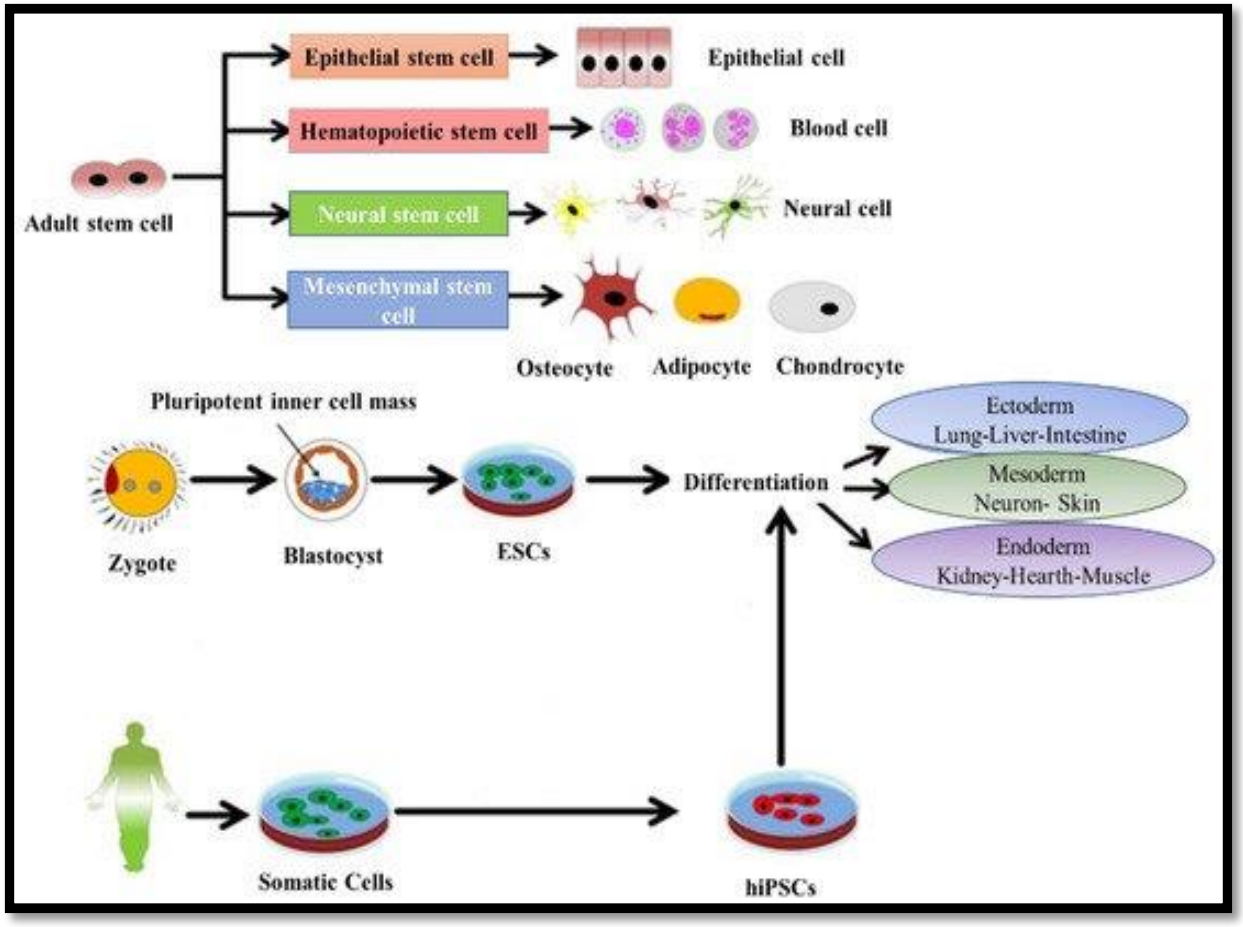

Figure 3 The primary designation and pedigree of stem cells, as well as their capability to develop into diverse heritage, are depicted in this diagram [39]

Nanoparticles Applications for Stalking Stem Cells

For non-invasive cell tracking, a nanoscale particle Superparamagnetic Iron Oxide (SPIO) is emanating as an ideal examination. However, in the progress of newly discovered labeling policies its low intracellular labeling proficiency has limited, its use and stimulated attentiveness. In nanoparticle Neuro-micro scans, the peculiar frequency of the fluorine amalgamation can be tuned up. This approach eradicates the backcloth gesticulations that meddle in medical imaging. Contradictory designation of cells could be stamped with incompatible compounds and then discovered independently by tuning the MRI scanner. Different techniques are used in stem cell tracking as shown in Figure 4 [40-42].

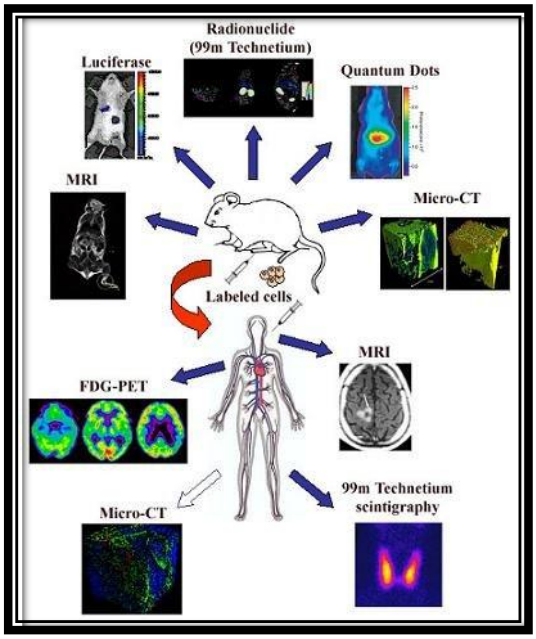

Figure 4 Stem cells tracking by nanotechnologies [43]

Applications of Nano-biotechnology in Parasites

Proteins play an extensive character and constitute functionality, for regulating the biological phenotype in flourishing and non-flourishing states. As a result, in diagnostics and pharmaceuticals proteomics is great conspicuousness, where the gesticulating pathways may be re-orientated by a magic bullet. Protein chips can be treated by the use of small modular protein components or chemical groups. They can shackle to proteins with an indisputable biochemical or structural design. In immediate years, drug-target pioneering chemical proteomics has prospered as a vigorous harmonious blueprint. This methodology utilizes little medication-like particles that can be bound to a ligand and render inactive on a strong help or presented to protein chips. Hence, those proteins bound to the ligand are distinguished as aptitude medication earmarks.

Liposomes are composed of phospholipid bilayers and they have spherical vesicular structures, concentrically positioned throughout aqueous chambers, present as a transporter of hydrophilic or lipophilic medications. In reality, by ameliorating magic bullet appropriation, reducing antidote toxicity, accumulating biological half-life, and improving the restorative denouements of condensed antidotes [44]. These frameworks cooperate with cells through endocytosis simple adsorption, lipid exchange, and fusion with cell membranes, and these are both bio-viable and biodegradable. They have been utilized to convey artemisinin and its byproduct with a legitimate biological scheme, contrasted with free artemisinin and its byproduct. For anti-leishmanial remedy, focusing on a magic bullet can be accomplished by liposomal condensed antidotes, allowing them to arrive within a cell Leishmanial amastigotes. The antidote- accommodating liposomes, by phagocytosis naturally gain access to the macrophages, and hence, the antidote is conveyed passively to the phagolysosome where it can straightforwardly take action on parasites [45].

Biological Effects and Therapeutic Applications

Magnetic nanowires are one more illustration of paramagnetic nanomaterial particularly reasonable for Nano-biotechnology implementation due to their anisotropy and size (conventional anisotropic magnetic nanoparticles dissimilarities). Nickel nanowires and growth in alumina membranes have been shown by Prina-Mello and co-workers that can be utilized for cell manipulation distinguishing proof and partition and can be introduced into adherent and suspended cells. The writer has additionally expressed that internalized nanoscale wires can be controlled (re-arranged) in the inner part of the cells without instigating any anisotropy in the inhabitants of adherent cells [46].

Health-Giving Applications

Nano biotechnology can produce new formulations of antidotes with fewer consequences and more effective routes for drug delivery.

Magic Bullet Delivery

Nanoscale particles as health-giving can be conveyed to delegated locales, they including areas that can't be reached standard medications handily. Simultaneously, by decreasing the viable dose expected to treat the patient harmful consequences from intense prescriptions can be stayed away. Delivery can be controlled considerably more exactly than any time in recent memory, by epitomizing drugs in Nano-sized substance (like natural dendrimers, empty polymer cases, and Nano-shells). Just as for imaging applications, magic bullets are deliberated to deliver a helpful payload (radiation, chemotherapy or quality treatment).

Gene Delivery

The inherent restrictions of victorious pharmaceutical processing and manufacturing, as well as the engineered mutant risk of reversion to the natural category, plague current gene therapy systems as shown in Figure 5. The viral vectors of immunogenicity utilize for gene delivery are also a concern in this topic.

As a result, the effective initiation of a less immunogenic Nano-size gene transporter as a replacement for the controversial viral vectors appears to be advantageous in human gene repair or replacement [3].

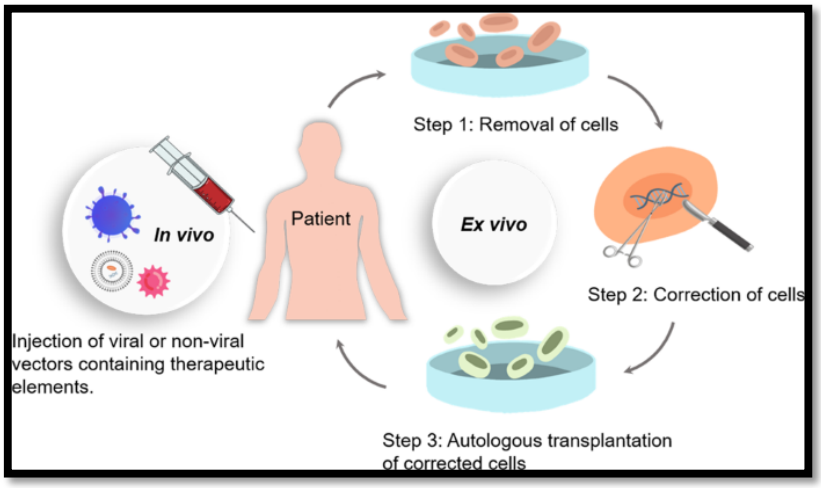

Figure 5 This diagram describes the gene therapy process and its types: In-Vivo and Ex-Vivo [47]

Nanoparticles Utilized for Invention of Biomarkers

Recently, to recognize biomarkers of different infections accessible molecular diagnostic advancements have been utilized. Nanobiotechnology has rectified the discovery of biomarkers. The premise of inventive molecular diagnostic tests some biomarkers are also taken. For creating biomarker-harvesting platforms the qualities of physicochemical and high surface areas of nanoparticles make them ideally possible. Designated the assortment of nanoscale particle advances that are accessible, selectively tie a subset of biomarkers and sequester them for later study utilizing high-sensitivity proteomic tests, it is feasible to tailor nanoparticle surfaces [40]. Biomarker harvesting is probably undergone substantial development and it is an underutilized nanoscale particle technology. For expeditious identification of biomarkers and DNA division the functional polymer-coated nanoscale particles can be utilized as shown in Figure 6 [41].

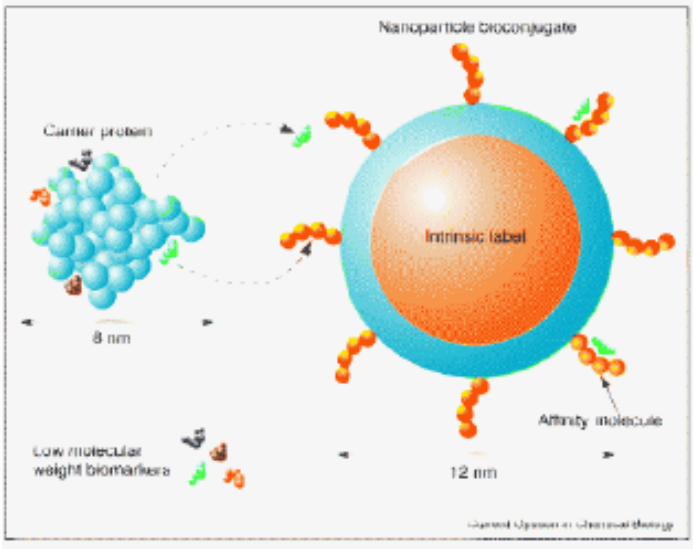

Figure 6 Nanoparticles as a potential biomarkers harvester

Nanoscale particles used for Molecular Diagnostics

A few nanoscale particles have been utilized for diagnostics. According to this, the most frequently utilized are gold nanoparticles, magnetic nanoparticles, and QDs [40].

Recent Advancements in Nano Biotechnology

In the field of Bionanotechnology, the advancements are in the emergence of a new era in the history of global technology. Some recent advancements include the use of quantum dots, which are semiconductor crystal particles whose physical dimension is in nanometers. Moreover, they have good conductive properties [48]. These quantum dots are useful in the imaging of the living cell as well as in the imaging which is helpful in medical diagnostics. In addition to it, gold nanoparticles and magnetic nanoparticles are also used for image-guided surgery and drug delivery [49]. Metallic nanostructures are also developed which could be used in Surface Enhanced Raman Spectroscopy (SERS). These metallic nanostructures could also be engineered with photo-thermal properties, which are ultimately helpful in laser ablation therapy. One of the main goals of Nano-biotechnology is to develop multifunctional Nanodevices that have improved sensitivity and great clinical applications [48].

Another recent advancement in this field is the development of the Nano-plasmonic sensors which are helpful in the detection of biomolecules and aid in various fields of sciences like medicine and environmental studies [50]. Bionanotechnology is working on contact lenses that would meet virtual reality so that there will be no need for heavy headsets and virtual boxes. Scientists are also trying to develop Nano detectors that would be helpful in pre-detection of the heart attacks. Trails are also being done for the development of the physical antibodies which would fight off bacteria and are primarily made up of black silicon. It has also been found that silver nanoparticles have a great ability to kill bacteria, so they are helpful in self-sanitizing toothbrushes and may also be used in toothpaste in the future. Recently, scientists have developed tiny micro-bots that are magnetically guided and are helpful in eye surgeries or the delivery of a precise amount of drugs to specific parts of the body [51]. The emerging trends in Bionanotechnology include the use of Nano size particles for the treatment of retinopathy, as it is a very tough task to effectively deliver the drugs to the posterior segment of the eye. Other focuses include the treatment of respiratory disorders and the achievement of effective therapeutic levels in the central nervous system, which is difficult due to the blood and brain barrier. The use of the non-immunogenic and non-viral Nanoparticulate carriers for gene therapy is another milestone of Nanobiotechnology so that the risk of infections from other attenuated viral vaccines can be lowered [52].

Recent researches also include the use of Nanophotonics for the manipulation of the different molecular processes occurring in living organisms [53]. Scientists are working on the development of a Nano bionic system for the plants by Nano-engineering the organelles of the plant. Moreover, scientists are trying to develop Nano silica-based fertilizers which increase the rate of growth of the plant as well as the process of germination. Fruit coating has also been introduced, which increases the shelf life of the fruits [54]. Nowadays, nanotechnology has also been applied in agricultural fields for the enhancement of agricultural productivity. The correct dosage of fertilizers and water could also be given by Nano-porous zeolites that are more efficient, and ensure the slow release of nutrients to the plants. Nanocapsules are being used for herbicide delivery. Moreover, plant health and soil quality could be enhanced with the help of Nanosensors. Nanomembranes could also be used for the purification of water, detoxification, and desalination. Pathogens and contaminants could also be detected with the help of biosensors [55]. Another idea is the self-replicating nanotech weapons that will be probably bacteria-like replicators. In the future, the world may develop such small-sized but highly efficient programmable weapons by using the combined knowledge of artificial intelligence and nanotechnology [56]. Recently, scientists are trying to develop a powerful weapon against COVID-19 in the form of Nanobodies which are antibodies but are smaller than the antibodies present in the human body. Lipid Nanoparticle In-capsulated mRNA vaccine has also been developed against SARS-CoV-2. In addition to it, researchers have developed the Aerosol jet 3D printer, which is helpful in the detection of COVID-19 antibodies within 10 seconds. Scientists have recently developed an air-powered generator which is called Airgun. It has protein nanowires which are made up of the microbe Geobacter, these proteins conduct electricity. So the electricity is produced with the help of the water vapors present in the atmosphere [57].

Today Bio-Nanotechnology

Bio-nanotechnology is now a substantiality; in certainty, it is a burgeoning field. It is an exciting time to be operating in bio-nanotechnology.

The entirety is new in this field, and there are new disclosures recorded every day. Because bio-nanotechnology is now driven by brilliant people, it's an especially exciting schedule to be operating in this subject. A brilliant new idea can open hitherto unexplored areas of experimentation and employment. The first fulgurating of Nano-medicines is permitting researchers to make beneficial changes to the mechanisms of the human body, correcting defective genes and curing disease. Natural materials, such as wood, bone, and shells that we are familiar with are offering the postulates necessary to manufacture materials that are adapted to our needs at the nanoscale. The biological procedure of nanoscale enlightenment retrieval and storage is being made productive to interpret computational complications and crook criminals [1].

Future Prospects of Nano-Biotechnology

About the future imputations of Nano-biotechnology, there are a lot of discussions. It could make and recommend the accomplishment of a choice of numerous new substances and gadgets conceivably valuable in the medication field, biomaterials, hardware, and energy production. Nevertheless, this methodology raises considerable problems as any new technology, including concerns with toxicity and ecological influence of nanoscale materials and their aptitude consequences on global economics, just as conjecture about innumerable doomsday scenarios. Special statutory regulation of Nano-biotechnology is justified. These scrutinize have represented a discussion among advocacy groups and legislatures.

The incapability to evaluate essential proteins expressed at numerous malignant growth stages is perhaps the greatest challenge facing cancer diagnostics. The aim is to overcome the recently limited point of view in researching infections by utilizing upregulated proteins in inspecting damage or in pathological processes to particular organs like the heart, kidneys, or lungs to detect disease. Proteomics is quickly turning into an applicable device in the field of biotechnology. New and improved antidotes and biomarkers can be created, by examining proteins communicated by these organs. Subsequently, by utilizing CTX in the development of new and powerful cancer diagnostic markers proteomics can be used as a powerful tool [58].

Its time-ahead application as regenerative and diagnostic medicine is recently being investigated. Continuous advancements in small-scale medicine have opened up the appropriate time for implementation in an assortment of therapeutic disciplines. In terms of diagnostics, detection of unhealthy cells would be quicker, possibly at the level of a single sick cell, allowing unhealthy cells to be healed without a moment's delay as they spread and influence the different parts of the body. Additionally, individuals experiencing major traumatic injuries and impaired organ functions could profit from the utilization of nanoscale medicines [59].

Nano Biotechnology Institutes

Research worker organization with mechanical to establish extraordinary gene therapy/disease analysis.

- A company-related association for Nanobiotechnology holds immaculate the invention of current virus variables for absolute germline disease analysis for long-suffering people.
- Viruses are proficient at bringing the anatomy as SARS-COV-2 disease has been extensively determined. Virus variables are altered disease/virus.

Branch chamber improve. Hopkins bioengineers acquire procedures from computer technology to determine a component in branch chamber development [60].

Over at lowest two centuries, the technological borough has verified an extraordinary accumulation of Nano-biotechnology inquiries in Canada. The current assay discovers a fast accumulation of Nano-biotechnology inquiries in Canada. In the current period, inquiry matter has displaced against the Nano-biotechnology tract [61].

Challenges for Nano-biotechnology

No one faces the challenges of nanotechnology. There will be no more than one cluster or academic field. The key difficulty is to create ways for determining how much exposure to artificial nanomaterials in the air and water is harmful. It is recognized that human and animal exposure to potentially contaminated settings with nanomaterials may need to be monitored for potential harm. Complex matrices, such as food, make the challenge even more difficult. Within the next 5 years-15 years, another issue will be the development of technologies to detect and quantify the toxicity of manmade nanomaterials. Models for estimating the influence of these nanomaterials on human health and, by extension, the environment will be an inescapable challenge once again. The next step is to create an inverse system for evaluating the long-term consequences of produced nanomaterials on human health and the environment. It talks about life cycle issues. Another significant difficulty is the creation of instruments that can accurately assess human health and environmental concerns. The development of Nano biotechnologies faces several obstacles, including a lack of confidence in the efficacy of advances such as efficiency, scalability, financing, limited resources, and patience. The vast majority of companies recognize that nanotechnology has great potential to develop new products and thereby improve existing products. New potentially disruptive technologies, such as nanotechnology, make new regulatory requirements more difficult. Authorities all across the world must analyze the potential risks and government responses to the full implementation of this modern technology [3].

Nano Ethics

Nanoethics is an emerging field of look at that is concerned with examining of moral and social implications of nanoscale science and technology. Nanoethics attention on those public and policy problems related to Nanotechnology studies and development [62].

Limitations of Nano Biotechnology

Nanoparticles may have damaging results on each organic structure and human fitness. Although the technical aspects lie past the scope of this paper, such chance checks bring a few critical moral components. What constitutes suitable or unacceptable dangers as soon as the clinical information is to be had as compared, say, with present risks, including debris from diesel emissions? How precautionary must we be with risks which can take a long time to assess? Against what standards should we weigh the capacity of Nano biotechnologies for each environmental easy-up and ecological risk much vaunted function of nanotechnology is its ability for backside-up construction. Drexler (1986) claimed that biological systems use poor substances and designs that human ingenuity may want to improve on. By contrast, Richard Jones argued in a lecture at the Institute of Nanotechnology's conference entitled Converging Technologies. Properly and are tremendously optimized to their surroundings. Therefore, future applications of Nano biotechnologies could use such naturally developed designs as part of large artificial structures. Jones is outstanding between self-meeting intended to imitate living systems and the incorporation of additives from residing structures into larger devices. Applied to human beings, such strategies enhance critical ethical questions about the body–machine interface [63].

It is a common mistake in the medical realm to believe that a generation is ethically neutral. Technologies replicate the values of the society inside which they may be produced. As they end up an integral part of society, technologies in turn reshape values and expectations-regularly unconsciously-in a synergic relationship. The thesis is probably seen as an unwritten social 'settlement'. Society commonly welcomes a brand new technology if it fulfills sure situations-if the values and goals of the inventor are near the ones discovered in the society, and if the invention anticipates what society wishes, as, for example, with the cellphone. However, there also can be disjunction if the imaginative context is remote from the wider society, if the inventor's objectives no longer correlate with society's values and desires, or if the discovery is surprising or risky. This befell Gumwood products, for which the social agreement failed because positive key implicit conditions had been no longer met.

The question then is whether or not traits as the novel, distinctly technical, and far-flung from most people as Nano biotechnologies mirror extensively shared values of society as an entire, as opposed to the values of an elite with ways-accomplishing powers. We have to therefore determine emerging packages to peer wherein their using forces cohere or battle with typical societal values, in which there are synergies or disjunctions, areas of war, or risks to avoid, and whether the claimed blessings are indeed desired or wanted. In this context, the concept of development and the idea of the person are two important problems about which those engaged in research can also make implicit or specific assumptions, depending on their worldview or orientation [64].

Deep expertise in the physicochemical residences of nanomaterials and their overall performance is critical to evaluate their capability risky results on organic systems, the human frame, and specifically the environment. The size distribution of nanomaterials in a biosystem is constantly converting due to the agglomeration/aggregation of particles. Besides dangers related to the manufacturing and overall performance of nanomaterials, their waste products, in most cases, additionally purpose potential problems to human health. For example, the burning of garbage which includes textiles, batteries, and different Nano technological merchandise can separate carbon nanotubes from product matrixes. Because those carbon nanotubes do not smash down at temperatures below 850°C, they can survive and be inhaled or added into the food chain as hazardous substances. Another example is the application of nanomaterials in apparel which ends up in their direct contact with human skin and hence the possibility to penetrate the body [65].

In reality, the interplay of launched nanostructures with air, water, and soil efficiently reason modifications in their floor residences, generating aggregation or adjustments in particle rate, etc. Although nanotechnology is making big enhancements in technologies used to guard the environment, inclusive of more desirable sensing, remedy, and remediation of environmental contaminants, studies and investment are likewise required to discover its unfavorable effects. In addition to the troubles already raised, a few nanoparticle core substances are toxic to the surroundings-nanoparticles are regularly covered with exceptional cloth that contains a pore size greater than the size of the particles [66].

CONCLUSION

This review article provides an overview of Nano-biotechnology and its applications in various fields. It highlights the characteristics and types of different nanoparticles which includes carbon-based, polymeric, metal, and ceramic nanoparticles. These Nano-particles are used in crucial processes like tracking stem cells and discovering

biomarkers. Moreover, this article also emphasizes the significance of Nanobiotechnology in Bio-formulations, Bio-mimetics, and Nano-fabrication. Nano-biotechnology has great potential for advancement in the field of medical science that ensures improved health care practices. The idea of implementing the knowledge of Nanobiotechnology in gene delivery, drug delivery, Stem cell-based therapy, and cancer diagnostics has opened a new world of innovations in the field of medical science. However, some scientists also have concerns about biosafety, environmental hazards, and contamination caused by Nano-materials, which should be addressed and cannot be denied. Recently, different developments and improvements have been initiated in this domain and within no time there will be a remarkable impact of Nano-biotechnology in every sector of life. In a nutshell, Nano-biotechnology is a blooming field of science and it will continue to spellbound humanity through its eye-opening advancements.

DECLARATIONS

Conflict of Interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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