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NANOTECHONOLOGY AND ITS DRUG DISCOVERY

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ABSTRACT

Finding, creating, and testing novel drugs to treat illnesses is all part of the intricate and multidimensional process of drug discovery. Drug development is a multi-phase process that includes target selection, validation, lead optimization, discovery, Paraclinical research, clinical trials, and approval. It is a sophisticated and involved procedure. To guarantee the safety and effectiveness of possible treatments, each step necessitates meticulous scientific inquiry and review. A successful drug discovery process can lead to medicines for a variety of diseases that can change people's lives and raise the standard of healthcare generally, despite the difficulties and unknowns.The multidisciplinary field of nanotechnology deals with the manipulation of materials at the nanosecond, usually down to the level of individual molecules and atoms. This new technology has the potential to completely change a number of sectors. Scientists and engineers can develop unique shapes, characteristics, and functionalities by manipulating and engineering materials at the nanosecond. Nanotechnology has the power to completely transform industries like energy generation, materials research, electronics, and medicine. It makes it possible to create lighter and more durable materials, more focused drug delivery systems, and incredibly efficient electronics. But its use also brings up moral and security issues, highlighting the significance of appropriate research and implementation. All things considered, nanotechnology holds the potential for previously unheard-of innovation and social influence.

KEYWORDS:

Nano particles, dendrimers, nano spores, nano sponges,

1. INTRODUCTION: NANOTECHONOOGY

"Nanotechnology" refers to the field of study and technology development at the atomic, molecule, and macro molecular scales that leads to the controlled modification and study of materials and devices with

length ranges ranging from one to 100 nanometre. Things such as "Nano particles" take on distinct roles and properties at this scale that distinguish them from bulk-scale observations. The minuscule size, customization surface, improved solubility, and versatility of Nano particles present a multitude of novel research options for biologists. Even at the size of individual proteins, nanomaterials can interact with complex biological processes in innovative ways due to their unique properties. Thanks to this rapidly developing field, interdisciplinary researchers can now produce nanoparticles with multiple functions that can target, detect, and cure diseases like cancer. (Sakthiselvan, P., & Madhumathi, R. (2018).)

From nanotechnology's inception, great advances in genetics, medicine, communications, and robotics have been promised. It seems that physical, chemical, and biological elements can be had for less money and with faster functionality because to miniaturization. Less obvious, though, is the fact of nanoscale things also display amazing ordering themselves and assembly behaviour when subjected to stresses substantially different than those of macroscopic objects. These unique behaviours make nanotechnology possible, and as our knowledge of these mechanisms expands, new approaches to enhancing the quality of human existence will surely be developed. Though it would be impossible to include everything on the myriad applications of nanotechnology, *(Bhushan, B*  *. (2017).*

Fig 1. nano materials classification .

2. HISTORY AND CAUSE

Following physicist Richard Feynman's seminal speech "There's a Plenty of Room at the Bottom," which explored the potential for controlling individual atoms and molecules, the current notion of nanotechnology started to take shape in the 1950s and 60s. This paved the way for nanotechnology to become its own independent field of study. (***T****olochko, N. K2009)*

For the first time, scientists were able to see and work with individual atoms and molecules in the 1980s with the development of a scanning tunnelling microscope (the STM) and the atomic force microscope (AFM). These Developments cleared the path for the emergence of nanoparticles as a useful technology and provided new avenues for investigating the properties of substances at the nanoscale (Binnig, G.; Rohrer, H.; Gerber, et.al 1982,)

2.1NANOTECHNOLOGY IN INDIA

In 2001, the Nano science and Technology Initiative was established, and with an initial financing of Rs 60 crore, nanotechnology was introduced in India. A five-year program called Nano Mission was introduced by the Government of India in 2007 with a budget of Rs. 1000 crore. *(Kumar, A. (2014).)*

The mission encompassed the following areas: worldwide collaboration, infrastructure development, human resources development, and basic nanotechnology research. Numerous departments have been enlisted for the task, including the (CSIR), the Department of Biotechnology, the Department of IT, and DRDO.(Beumer, K., & Bhattacharya, S. (2013).

3. UTILIZATION OF THE NANOTECHNOLOGY IN VARIOUS FIELDS

Many possible uses of nanotechnology in daily life could revolutionize anything from consumer goods to medical treatments. The following represent a few of the most notable methods by which nanotechnology is influencing our daily lives:

1. Medical: The realm of medicine is being revolutionized by nanotechnology. Treatment efficacy can be increased and adverse effects can be decreased by using tailored nanoparticles to deliver medications directly to the targeted cells. Additionally, novel diagnostic instruments like biosensors that may identify disease biomarkers at the very beginning are being developed using nanotechnology. (Nasrollahzadeh, M., Sajadi, et al (2019).)

2. Electronics: The development of more compact and potent electronics is made possible by nanotechnology. Transistors and memory chips, for example, are being made to function better by using materials and structures at the nanoscale. Additionally, flexible and transparent electronics are being developed thanks to nanotechnology, which may result in the development of new kinds of screens and sensors. (Rae, A. (2006).)

3. Consumer goods: A variety of consumer goods, including clothes and cosmetics, now incorporate nanotechnology. New materials with better qualities, like lighter and more powerful plastics, more resilient coatings, and fabrics that resist stains, are being made utilizing nanomaterials. Additionally, novel materials for food packaging with better barrier qualities and longer shelf lives are being developed using nanotechnology**.** (Mu, L., & Sprando, R. L. (2010).)

4. Food production: The manufacturing and packaging of food could be completely transformed by nanotechnology. In order to create novel food additives with better qualities, including better flavour or texture, nanomaterials are being used. Additionally, novel food packaging materials with better barrier qualities and longer shelf lives are being developed using nanotechnology (Predicala, B., 2009.)

5. Defence and security: The fields of defence and security are seeing rapid progress because to nanotechnology. Nanomaterials are being utilized, for instance, to create novel, highly durable, and

lightweight body Armor materials. The creation of novel sensors, surveillance tools, and explosives detecting technologies is another area of research into nanotechnology. (Kosal, M. E. (2014).)

These are but a handful of the ways that nanotechnology is influencing our day-to-day activities. We may anticipate seeing even more cutting-edge uses for nanotechnology in the years to come as this field of study and development develops.

4. NANOTECHNOLOGY IN DRUG DISCOVERY /NANOTECHNOLOGY RELATED TO MEDICAL FIELD

Drug discovery has undergone a revolution because to nanotechnology, which has made new tools and methods for creating unique treatments available. There are many different ways that nanotechnology is being used in drug research, such as systems for delivering drugs, imaging methods, and diagnostic tools. These developments could greatly aid in the creation of personalized medicine and greatly increase the safety and effectiveness of pharmaceutical therapies. (Singh, A., & Amiji, M. M. (2022).)

Fig 4.applications of nanotechnology in health care.

The creation of targeted medication delivery systems is one of the main advantages of nanotechnology in drug research. Embedded nanostructures within or on the surface of medical devices, including surgical implants, are projected to present very little risk for medical applications as long as they stay fixed. **(**de Jong, W. H., Roszek, B., & Geertsma, et al (2005).)

Doctors could carry out precise cellular and molecular manipulations with the use of programmable nanorobotic devices. In addition to manually reversing coronary artery disease improving respiratory capacity, allowing near-instantaneous homeostasis, bolstering the immune response, altering or substituting sequences of DNA in cells, fixing harm to the brain, and resolving large cellular insults whether resulting from irreversible processes or by cryogenic preservation of biological tissues, medical nanorobots have been

suggested for use in genotological,clinical diagnosis, and dentistry applications(Patil, M., Mehta, D. S.,et al(2008).)

Fig 5. lipo nano medicine delivery

Through the fabrication of nano-sized carriers, such as liposome, nanoparticles of polymers, or dendrimers, scientists can create systems for drug delivery that minimize side effects while precisely targeting sick tissues or cells. This focused strategy may raise drug accumulation at the location of action, decrease systemic adverse effects, and raise the therapeutic efficacy of pharmaceuticals. Nanotechnology has made it possible to construct sophisticated imaging and diagnostic instruments for drug discovery as well as to targeted drug delivery. Imaging agents, including fluorescent dyes or contrast materials, can be functionalized into nanoparticles to allow for the real-time viewing of biological reactions at both the molecular and cell levels. (Surendiran, A., Sandhiya, et al (2009).) (Zdrojewicz, Z., Waracki, M., Bugaj, B.,et al (2015))

High-throughput screening methods and innovative drug screening platforms have both been made possible by nanotechnology. Through the use of Nano-engineered materials, like nano arrays or microfluidic chips, scientists can develop highly parallelized, compact tools for drug screening that enable the quick and economical assessment of sizable compound libraries. This could greatly speed up the process of finding new drugs and raise the possibility of finding promising therapeutic possibilities. (George, R., Hehlgans, S., Fleischmann, et al (2022).)(Tibbals, H. F. (2017).)

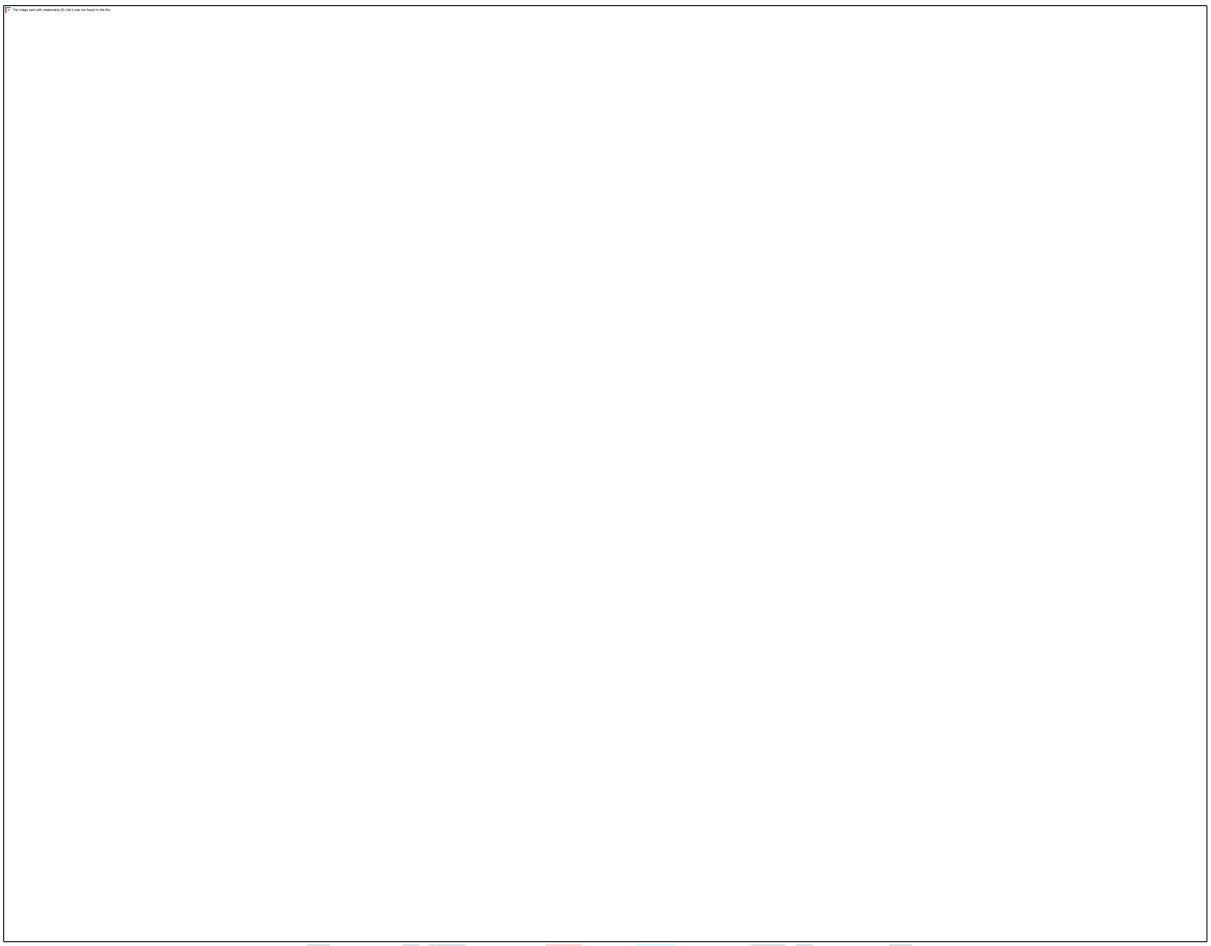

Fig 6. drug delivery

The application of nanotechnology in the development of drugs has also sparked the creation of cutting-edge therapeutic approaches including gene editing and RNA interference (RNAi). Nucleic acid-based therapies, such as CRISPR/Cas9 tools for gene editing or small interfering RNA (siRNA), can be delivered to certain target cells or tissues via nanomaterials. This could be a game changer in the treatment of cancer, genetic diseases, and other illnesses for which conventional small molecule medications are not very effective. (Moshed, A., Sarkar, M. K. I., et al (2017))

Because it has made it possible to create tailored drug delivery systems, sophisticated imaging and diagnostic instruments, cutting-edge drug screening platforms, and cutting-edge therapy modalities, nanotechnology has had a significant impact on drug discovery. (Moshed, A., Sarkar, M. K. I., & Khaleque, M. A. (2017))

5.NANOTECHNOLOGY IMPACT ON ECONOMY AND SOCIETY:

The economy could be significantly impacted by nanotechnology in a number of ways. These are a few of the most significant ways that nanotechnology is impacting the economy**.** (Knell, M. (2011)

Jobs: Research, development, manufacturing, and other high-skilled jobs are being created by the creation and marketing of nanotechnology-based items and applications. These jobs are growing across a variety of industries, from medical care and electronics to materials and energy. (Wessner, C. W., Howell, T. R., Wessner, C. W., et al (2020).)

Increased productivity and efficiency: Nanotechnology has the potential to improve productivity, employment and efficiency in manufacturing and other sectors. Nanotechnology could enable the development of new materials and processes that reduce waste and improve the performance of products. (Invernizzi, N. (2013).) (Rana, R. A., Siddiqui, M. N., Skalicky, et al (2021)

Enhanced competitiveness: By investing in nanotechnology research and development, countries and companies can enhance their competitiveness in the global marketplace. The ability to develop and commercialize innovative nanotechnology-based products and applications can give businesses a competitive edge and open up new export markets and revenue streams (Ghasemi, I., Abdi, E., Yaghmaei, O.et al (2015).)

Fig 9.nanotechnology impact on economy of different countries

New market potential: Businesses in a variety of industries are seeing new market prospects as a result of nanotechnology. For instance, new prospects in the field of renewable energy may arise from the growth of nanoparticles for energy storage. Similar to this, novel drug delivery, medical device, and diagnostic technologies are being developed as a result of the application of nanotechnology in healthcare. (Milanović, V., & Bučalina, A. (2013).) (Gao, Y., Jin, B., et al (2016)

Sustainable development: By facilitating the creation of more effective and ecologically friendly goods and procedures, nanotechnology has the ability to support sustainable development. For instance, the application of nanotechnology in materials, energy, and water purification can result in the creation of more long-term solutions for urgent global issues.

Infrastructure development for nanotechnology: Establishing research centres and manufacturing facilities, for example, might have a substantial economic impact. (Shapira, P., & Youtie, J. (2015).) (Markovic, D. S., Zivkovic, D., et al (2012)) (Hutchison, J. E. (2016).)

financial effect. These facilities' development and upkeep support employment and economic activity, and their capabilities could encourage the creation of new goods and advances in technology. In the years to come, it is anticipated that nanotechnology will make even more contributions to global growth and development**.** (Shah, S. S., Shaikh, M. N., Khan, et al (2021).)

6.CONCLUSION: -

In conclusion, nanotechnology is emerging as a ray of hope offering an innovative toolkit to address current global challenges, improve healthcare, and accelerate sustainable energy initiatives. . The ability to meticulously design and manipulate materials at the nanoscale usher in a new era of possibility. There, targeted drug delivery systems and advanced medical diagnostics have the potential to revolutionize medical outcomes. At the same time, the use of nanotechnology in sustainable energy solutions promises to improve the efficiency of energy use and storage, paving the way for environmentally friendly alternatives. However, delivering on these promises depends on an honest approach to development. We must navigate the complex landscape of nanotechnology with an unwavering commitment to safety, ethical considerations, and a keen awareness of the impact on society. In this way, the benefits of nanotechnology can not only be harnessed for

innovation, but also used responsibly and sustainably to protect human well-being and the health of the planet.

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