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Nanoparticle: As Novel Drug Delivery System

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ABSTRACT:

Nanotechnology can be defined as a technology that enables the control, manipulation, study, and production of structures and devices in the "nanometer" size range. These nano-sized objects, such as ``nanoparticles", take on new properties and functions that are significantly different from objects made of the same material.Nanomedicine has rapidly developed to treat certain diseases such as brain tumors. Lung cancer, skin diseases, bone diseases, cardiovascular diseases, etc. These nanomedicines can ameliorate medicine bioavailability and immersion time, dock release time, help medicine aggregation, and ameliorate medicine solubility in blood. This review involves various types of nanomaterials used in nanotechnology for drug delivery and their various applications in the pharmaceutical drug delivery. Nanoparticles have one of the mostly used and attracted a lot of attention in recent times. Multitudinous ways similar as physical, mechanical, chemical, natural, and cold-blooded ways are available to synthesize different types of nanomaterials. The synthesized nanoparticles are in the form of colloids, clusters, maquillages, tubes, rods, cables, and thin flicks. The technique used depends on the material of interest, the type, size and amount of nanomaterials. The full potential of this technology can be exploited for the benefit of humanity. However, to fully understand the potential of nanotechnology, it is important to know what nanomaterials are and how these materials can be synthesized. This is attempted by presenting several techniques for synthesizing nanomaterials and included in this study.

Keywords: Nanomaterials, Nanoparticles, Nanotechnology, applications, etc.

1. INTRODUCTION

◆ **HISTORY OF NANOTECHNOLOGY**

Although nanotechnology appears to be a new facet of science, human use of nanotechnology is nothing new. The history of the use of nanomaterials in architecture dates back 4,500 years, when natural asbestos nanofibers were used in ceramic matrices. One of the world's oldest, richest and most advanced cultures, the Egyptians recognized the potential of nanomaterials 4000 years ago. A Journey Through the History of Nanomaterials and Nanotechnology up to the 2000s...

The first ever conception developed in 1959 by notorious drugs professor Dr. Introduced by RichardP. Feynman.

The invention of the scanning tunneling microscope in 1981 and his discovery of fullerenes(C60) in 1985 led to the emergence of nanotechnology.

The term nanotechnology was chased by Norio Taniguchi in 1974

◆ **DEFINATION & SCOPE**

In recent decades,there has been considerable research interest in this area of development of nanotechnology by using nanoparticles as carriers for small and large molecules. Various polymers have been used to formulate nanoparticles. This review introduces the most notable contributions in the field of nanotechnology. The word "nano" comes from Latin word meaning dwarf.Nanosize refers to one billionth of a specific unit so a nanometer is one billion of a meter (i.e. 1n=109m).

◆ **The following definitions for the major general terms are as:-**

1. **Nanoscale:** Having one or more dimensions on the order of 100 nm or less.
2. **Nanoscience:** The study of the manipulation of phenomena and materials at the atomic, molecular and macromolecular level. Its properties are very different from those at larger scales.
3. **Nanotechnology:** Design, characterization,fabrication & application of structures,devices & systems with shape and size control at the nanoscale.
4. **Nanomaterial:** A material that has one or more external dimensions or internal structure that may exhibit new properties compared to the same material without nanoscale features.

5. **Nanoparticles:** Particles with one or more nanoscale dimensions.

6. **Nanocomposites:** Composites in which at least one phase has at least one dimension on the nanoscale.

7. **Nanostructured:** Having a nanoscale structure,

Nanotechnology is a term used to describe the branch of science and technology in which nanometer-scale phenomena are used in the design,characterization, fabrication and application of materials, structures, devices and systems. There are many examples of nanometer-sized (hereafter, nanoscale) structures in nature, such as important molecules in the human body and food ingredients, and over the years many technologies have happened to include nanoscale structures. It's just a small part of the world. In the past quarter-century, it has been possible to actively and specifically modify molecules and structures in this size range. It is this nanometer-scale control that distinguishes nanotechnology from other engineering disciplines.

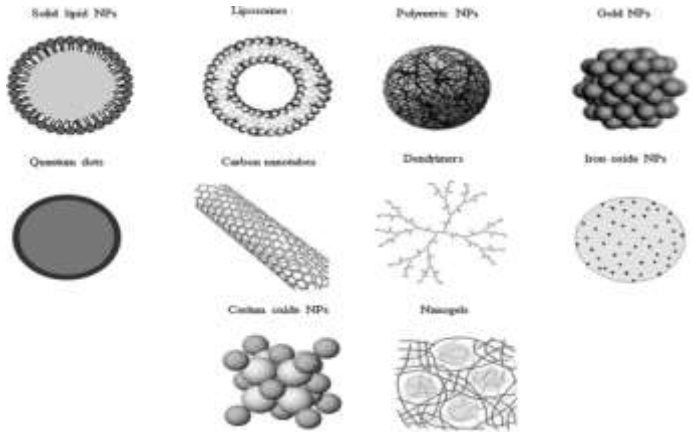

Fig.01: Various types of nano material used in Nanotechnology

The Commission believes that the scope of nanoscience and nanotechnology used by the Royal Society and Royal Academy of Engineering in their 2004 report (Royal Society and Royal Academy of Engineering 2004) adequately expresses these concepts. This suggests that the nanoscale range is atomic level from 0.2 nm to 100 nm. Within this range, materials can exhibit markedly different properties compared to the same substance at larger sizes. This is because the ratio of surface area to mass is much higher & quantum effects begin to play a role in these dimensions, resulting in large variations in different types of a physical nature.

Nanomaterials could enable mass production of products with improved functionality,significantly reduced costs, and greener and cleaner manufacturing processes,improving healthcare & reducing the environmental impact of manufacturing.

◆ POSSIBILITIES FOR FUTURE OF NANOTECHNOLOGY

Nanotechnology could enable creation of lighter, stronger and programmable accoutrements

• Requires lower energy to produce than traditional accoutrements .

• And it promises to ameliorate the energy effectiveness of land transportation, vessels, aircraft, and spacecraft.

The future of nanotechnology may include the use of nanorobotics.

These nanorobots have the eventuality to take on both mortal tasks and tasks that humans could noway negotiate. It may be possible to rebuild the depleted ozone subcaste.

There will be a whole field of nanosurgery that can treat everything from natural aging to diabetes to bone spurs.

There is veritably little that can not be repaired(ultimately) with the preface of nanosurgery.

◆ Advantages

1. Nanotechnology can actually evolutionize a lot of electronic products, procedures and application.
2. Promoting renewable energies.
3. It allows a more effective medicine.
4. It extends the limits of electronics.
5. Nanotechnology can also benefits the energy sector.

6. Another industry that can benefit from Nanotechnology is the manufacturing sector.
7. With nanotechnology we can create unique materials & products which are stronger,lighter, cheaper, durable & precise.
8. Industrial computers which made with nanomaterials can become a billion time faster & a millions time smaller.
9. It can be used to deliver medicine as it is readily absorbed.
10. In the medical world nanotechnology is also seen as a boon since these can help with creating what is called smart drug.

◆ **Disadvantages**

1. It's development is the possible loss of jobs in the traditional husbandry and manufacturing assiduity.
2. infinitesimal munitions can now be more accessible & made to be more important and more destructive.
3. Since these patches are veritably small, problems can actually arise from the inhalation of these.
4. Health and safety issues Nanoparticles can beget serious illness or damage to mortal body. Carbon nanotubes could beget infection of lungs.
5. Mass product in food & consumable, oil painting & Diamonds could come empty.
6. nanosecond patches, much like the problems a person gets from gobbling nanosecond asbestos patches.
7. Presently Nanotechnology is veritably precious and developing it can bring you a lot of plutocrat.
8. Creates social strife through adding wealth gap.
9. Nono pollution is created by poisonous waste.
10. Having short shelf life.

2. NANOTECHNOLOGY IN MEDICINE & HEALTHCARE

Nanomedicine is the scientific field that combines nanotechnology with medicines or individual moleculesnto ameliorate their capability to target specific cells ortissues.These accoutrements are manufactured at the nanoscale and can be safely fitted into thebody.Medical operations of nanotechnology include imaging, opinion, or medicine delivery to help medical professionals treat a variety ofdiseases.Use of nanoparticles in medical- electronic biosensors and molecular nanotechnology. Nanomedicine is presently being used to develop smart capsules and treat cancer.

◆ **CANCER DETECTION & TREATMENT**

Cancer treatments are currently limited to surgery,radiation therapy,& chemotherapy.All three methods carry the risk of damaging normal tissue or incompletely eradicating the cancer. Nanotechnology offers the opportunity to directly and selectively target chemotherapy to cancer cells and neoplasms,assist in surgical resection of tumors, and improve the therapeutic efficacy of radiation-based and other current therapies. A major problem with conventional chemotherapy and radiation therapy is damage to healthy body cells during treatment. New nanomedicine approaches are being used to treat skin cancer,enabling efficient delivery of drugs and other therapeutics to specific tumor sites and target cells with low toxicity side effects.

Fig 02.:- Use of nanotechnology in cancer treatment

A new method,NanoFlares, is being developed to detect cancer cells in the bloodstream using nanomedicine.Nanoflares are particles has bind to gene targets within cancer cells & produce light when that specific gene target is found,helping to detect it.

◆ **ORAL DRUG DELIVERY**

Oral administration is the most widely used form of drug delivery due to its ease of intake,cost-effectiveness,& versatility, as it can take a wide variety of drugs and ensures maximum patient compliance.This paper provides a comprehensive overview of the most promising and state-of-the-art engineered and surface-functionalized drug delivery systems and opportunities for the development of novel and robust delivery platforms for oral drug delivery.

Based on biopharmaceutical classification system (BCS) has number of new treatment units characterized as BCS Class II (Low Solubility and High permeablity) or BCS class IV (low solubility and low permeability). The gastrointestinal tract (GIT) also influences oral administration of drugs. Changes in gastrointestinal pH and the presence of various enzymes significantly impact on oral bioavailability of drugs such as antihypertensives,antibiotics, antihyperlipidemiatic drugs, etc. In addition, drugs with high first-pass metabolism.

◆ FORMULATION CONSIDERATION IN DRUG DELIVERY

The advent of combinatorial chemistry techniques and the search for physiologically viable targets using genomics and proteomics strategies has increased the number of NMEs considered for development. However, most of these new NMEs tend to have high molecular weight and partition coefficient (that is, logP) values,resulting in low water solubility and permeability, & most NMEs failed during development. The most common cause of failure approximately..

3. USE OF NANOTECHNOLOGY IN PHARMACEUTICS

◆ LIPOSOMES

Liposomes are globular vesicles characterized by a bilayer of lipids with an internal waterless depression, being one of the most successful medicine delivery systems applying nanotechnology to potentiate the remedial efficacity and reduce venom of conventionalmedicines.Topical operation of liposomes offers great openings in dermatology and anticancer medicine administration to reduce the poisonous goods of medicines when administered alone or to increase the rotation time and efficacity of medicines.

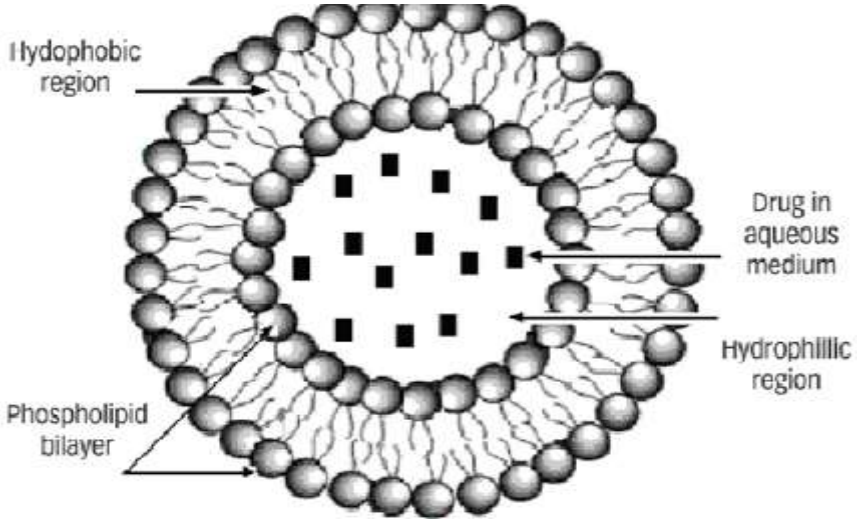

Fig 03:- Liposomes

Furthermore,liposomes cannot successfully cross the intact blood-brain barrier.In some cases,such as after trauma,certain disease processes, or tumors,damaged areas of the CNS may still be accessible because the BBB,which allows liposomes to pass more easily. A process known as active targeting may require more targeted methods that can facilitate passage across the BBB . Liposomes are versatile, their surface properties can be modified with polymers,antibodies,or proteins,& macromolecular agents such as nucleic acids and crystalline metals can be incorporated into the liposomes. In this approach the liposome surface can be modified with antibodies or ligands that specifically bind to target cells.Poly ethylene glycol (PEG)-conjugated liposomal doxorubicin (Doxil®) is the first FDA-approved nanodrug used to treat breast cancer, increasing effective drug concentration in malignant pleural fluid or effusion without increasing total dose. Liposomes are particularly effective in treating diseases that affect the immune system's phagocytic cells,as they tend to accumulate in phagocytic cell, which are known to be strange attackers.

◆ NIOSOMES

Niosomes are non-ionic surfactant- grounded vesicles that includenon-ionic surfactant and cholesterol as an excipient, employed for medicine delivery to specific spots to achieve asked remedial goods. Structurally, niosomes are analogous to liposomes, as they both correspond of a lipidbilayer.Various forces act within thevesicle.Van der Waals forces between surfactant motes, repulsive forces performing from electrostatic relations between charged groups of surfactant motes, entropic repulsive forces of head groups of surfactant motes, short- acting repulsive forces, These forces are involved in maintaining vesicle structure of niosomes. still, the stability of niosomes depends on the type of surfactant, type of medicine reprised, storehouse temperature, surfactant, use of transmembrane lipids, in situ interfacial polymerization of surfactant monomers, and chargedmolecules.Niosomes have

colorful operations, similar as gene delivery, medicine targeting, antineoplastic treatment, treatment for leishmaniasis, delivery of peptide medicines, studying the vulnerable response, carriers for hemoglobin, transdermal medicine delivery systems, and cosmetics.

◆ **EXOSOMES**

Exosomes are a class of cell- deduced extracellular vesicles of endosomal origin, and are generally 30- 150 nm in periphery – the lowest type of extracellularvesicle.Enveloped by a lipid bilayer, exosomes are released into the extracellular terrain containing a complex weight of contents deduced from the original cell, including proteins, lipids, mRNA, miRNA and DNA. The exosome face is girdled by colorful cell-specific proteins similar as Tetraspanins, integrins, colorful intercellular adhesion motes, or major histocompatibility complexes also set up on the face of exosomessurface.Exosomes are of general interest for their part in cell biology, and for their implicit remedial and individual operations. It was firstly allowed that exosomes were simply cellular waste products, still their function is now known to extend beyond wastedisposal.Exosomes have specific functions and play important places in colorful physiological processes and pathologicalconditions.As a result, exosomes are entering adding attention in clinical operations similar as prognostic, opinion, medicine delivery and vaccine development.

◆ **NANOPARTICLES**

In the last 50 years, material researches have been extensively studying how to exploit nanoparticles and nanostructured materials in the different biomedical and healthcare sector.Nanoparticles are the fundamental components of nanotechnology. Nano derived from the Greek word 'Nanos' that means DWARF or small. Nanoparticle is any material having atleast one of it's confines in range of 1- 100nm, that can be rearranged or reassembled into nano- systems with betteredfunction.Nanosized accoutrements nanostructured accoutrements are nanomaterials with one dimension in the nanoscale range(< 100nm) and are made up of a single material or multiple material. They can be made up of simple material. eg. Essence, Essence oxide, Carbon,etc.

◆ **NANOTUBES**

Nanotubes are formed by folding or rolling two- dimensional graphite into a spherical shape structure. Nanotubes are concave from outside. The periphery of the nanotube is around 1- 3 nanometers. The length of the carbon nanotube is much advanced than its periphery. Carbon nanotubes have excellent electronic, mechanical and chemical parcels. Nanotubes parade either metallic or semiconducting geste , depending on their specific periphery and the cling arrangement of the carbon tittles. Carbon nanotube technology has shown the eventuality to change medicine delivery and biosensing styles for the better, which is why carbon nanotubes have lately gained interest in the medical field.

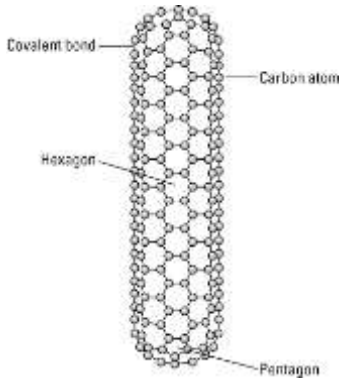

Fig 04:- Nanotubes

Due to their nanostructure and the strength of the bonds between carbon atoms, carbon nanotubes can exhibit remarkable properties such as excellent tensile strength and thermal conductivity. Some SWCNT structures are highly conductive, while others are semiconducting. Additionally, carbon nanotubes can be chemically modified. These properties are expected to be useful in many technical fields, including electronics, optics, composites, nanotechnology, and other materials science applications.

◆ **NANOROBOTICS**

Nanorobotics, or nanorobotics or nanobotics for short, is an emerging field of technology that produces machines or robots whose components are at or near the nanometer (10-9 meters) scale. Medical nanorobots represent a breakthrough innovation in the field of nanomedicine. These serve as specifically designed nanoscale devices to perform various biomedical tasks such as diagnosis, therapeutic intervention, and targeted drug delivery. Nanorobots are nanodevices used to maintain the human body and protect it from pathogens. Nanorobots are implemented by using various components such as sensors, actuators, control, energy, and communication to connect cross-disciplinary scales between organic-inorganic systems. One useful application for nanorobots is to help repair tissue cells, along with white blood cells. Recruitment of inflammatory cells or white blood cells to the affected area is the tissue's first response to injury. Due to their small size, the nanorobots can attach to the surface of collected white blood cells and penetrate blood vessel walls to reach the injury site and help repair tissue. Certain substances can speed recovery.

4. NANOPARTICLES

Nanoparticles are a fundamental component of nanotechnology. Nano comes from the Greek word "Nanos" meaning dwarf or small. Nanoparticles are any materials with at least one dimension in the range of 1 to 100 nanometers that can be rearranged or assembled into nanosystems with enhanced functionality. Nanoparticles are spherical polymer particles made from natural or artificial polymers. These particles range in size from 10 to 500 nm, and their spherical shape and high surface-to-volume ratio allow them to be used in a wide range of applications.

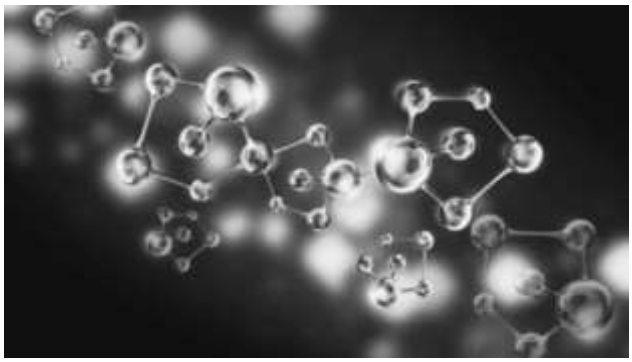

Fig 05:- Nanoparticle

Nanoparticles are sub-nanosized collidal structure composed of synthetic or semisynthetic polymers. Particles are the ultimate result of nanotechnology modification of matter and depending on their sizes they are a few degreez larger than an atom consequence and the molecular processing of matter.The recently the synthesis of nanomaterials by physical vapor deposition, chemical vapor deposition,3D printing, biochemical synthesis and supercritical fluid have gained importance which is mingled with other methods to improve the synthesis efficacy.

The materials used to manufacture nanoparticles must be non-toxic, biodegradable, sterilizable, etc. Their low AC and solubility properties, as well as their permeability, place them in class 2 of the Biopharmaceutical Classification System (BCS).

The National Institute of Medical Imaging and Biotechnology has announced the following outlook for future research in nanoparticle drug delivery systems.

- Combination of diagnosis and treatment.
- Overcoming the blood-brain barrier (BBB) in brain diseases and disorders
- Improve targeted intracellular delivery to ensure that therapeutic agents reach the correct structures within cells.

◆ **Ideal Properties of Nanoparticles necessary for Drug Delivery:**

1) It should be stable in blood.
2) It should be non-toxic.
3) It should be non-thrombogenic.
4) It should be non-inflammatory.
5) It should be non-immunogenic.
6) It should be biodegradable.

◆ **Unique Characteristics of Nanoparticles:**

1. Large surface to volume ratio.
2. High percentage of atoms/ molecules on the surface.
3. Surface forces are very important, while bulk forces are not as important.
4. Metal nanoparticles have unique light scattering properties and exhibit plasmon resonance.
5. Semiconductor nanoparticles may exhibit confined energy states in their electronic band structure (e.g.. quantum dots)
6. Can have unique chemical and physical properties.
7. Same size scale as many biological structures.

◆ **Routes of Administration:**

The nanoparticles enters in the body via:

1. Oral route
2. Nasal route
3. Dermal route
4. Intratumoral route
5. Pulmonary route
6. Opthalmic route
7. Subcutaneous or Intramuscular route
8. Intravenous route

- **Advantage**

1. Nanoparticles as drug carriers have better stability.
2. Naino particles have higher carrier capacity.
3. Possibility to incorporate both hydrophilic and hydrophobic substances
4. Feasibility of different management routes.
5. Nano particles are biodegradable, non-toxic and can be stored for a long time.
6. Nanoparticles reduce dosing frequency.
7. It can also be used in cosmetics because it penetrates deep into the skin.
8. Because it is easily absorbed, it can be used to deliver drugs.
9. Site-specific drug delivery.
10. Nanoparticles can help achieve maximum therapeutic efficacy with minimal side effects.

- **Disadvantages.**

1. Drug exposure is limited.
2. They are prone to bursting and leaking of contents.
3. Small size and large surface area can lead to particle agglomeration.
4. Handling nanoparticles in liquid and dry states is difficult.
5. High cost.
6. Toxic metabolites may be formed.
7. Productivity becomes more difficult.
8. Reduced ability to adjust dosage.
9. Advanced technology.
10. Crafting requires skill.

5. SYNTHESIS APPROACH OF NANOPARTICLES

There are two general approaches for the synthesis of Nanoparticles-

a) Top- down approach

b) Bottom–up approach.

(a) Top-down approach

Top-down approaches require breaking down bulk materials into nanosized fragments, structures, or particles.

Top-down synthesis techniques are an extension of techniques used to produce micron-sized particles.

Top-down approaches are simpler in nature and rely on either the removal or partitioning of bulk material or the miniaturization of bulk manufacturing processes to produce desired structures with appropriate properties.

The biggest problem with the top-down approach is the incomplete surface structure.

For example, nanowires created by lithography are not smooth and can contain many impurities and structural defects on their surfaces. Examples of such techniques include high-energy wet ball techniques, milling, electron beam lithography, nuclear manipulation, gas phase condensation, and aerosol spraying.

(b) Bottom-up approach

Alternative approaches that have the potential to reduce waste that's why "bottom-up" approach is more economical.

A bottom-up approach refers to building materials from the bottom up, atom by atom. per molecule or per cluster.

Many of these technologies are still in development or are just beginning to be used for commercial production of nanopowders.

Organometallic chemistry route,Livia micelle route, sol-gel synthesis,colloids precipitation,hydrothermal synthesis, template sol-gel, electrodeposition,etc.are some of the well-known bottom-up techniques for creating luminescent nanoparticles.

6. METHOD OF PREPERATION OF NANOPARTICLES

A. Physical method

- Mechanical method
- Laser pyrolsis
- Ionised cluster beam deposition

B. Chemical method

1. Sol-gel method
2. Sonochemical synthesis
3. Hydrothermal synthesis

C. Biological method

1. Synthesis using microorganisms
2. Synthesis using plant extract

A. Physical method

1. Mechanical method

Ball milling

An ingenious approach to manufacturing nanoparticles.The types of mills used include planetary mills,vibratory mills, rod mills, and tumbling mills.The container contains a hard ball made of steel or carbide metal.This method synthesizes nanocrystalline Co, Cr, W,and Ag-Fe. The ratio of ball to materials is 2:1. The container is filled with inert gas or air;rotates at high speed around the central axis. The material is pressed between the container wall and the ball. The speed and duration of milling play an important role in the synthesis of optimally sized nanoparticles.

Melt mixing

Mixing streams of molten metal at high speed and turbulently form nanoparticles.The nanoparticles are held within the glass. Glass – An amorphous solid with insufficient atomic or molecular symmetry.When metals with large cooling components are cooled,amorphous solid metallic glasses may form.Example: Molten Cu-B stream and heated Ti stream form TiB2 nanoparticles.

2. Laser pyrolysis method

The process of synthesizing nanoparticles using lasers is called laser pyrolysis. A powerful laser beam is focused to break up a mixture of reactant gases in the presence of an inert gas such as helium or argon.Gas pressure plays a major role in determining particle size and its distribution.

3. Ionised cluster beam deposition

This method was developed in 1985. The main goal of this method is to obtain high-quality single-crystalline thin films. The assembly includes an evaporation source,a nozzle for expanding the material into the chamber,an electron beam for ionizing the clusters,an assembly for accelerating the clusters,and a substrate on which a nanoparticle film can be deposited. All contained within appropriate containers,housing vacuum chamber.

Accumulation after electron beam collision ionize.The applied accelerating voltage concentrates the clusters near the substrate.The energy with which the clusters impact the substrate could be controlled by monitoring the accelerating voltage.Stable clusters of certain substances may be significantly required.They require energy to break their bonds & prefer to remain as small as particle clusters.Therefore,films of nanocrystalline materials can be fabricated using ionized cluster beams.

B. Chemical method

1. Sol-gel method

It's a chemical process that uses bottom- up approach. A sol is a type of colloild in which solid patches are suspended in a liquid. This patches are veritably small insize.Sols are generally miscellaneous admixture. A sol is a colloidal(dispersed phase in which size of flyspeck is so small that gravitational force don'texist.Only Vander Waals forces and face charge are present). A gel is asemi-rigid mass that forms when the detergent from the sol begins to dematerialize & the patches or the ions left before begin to join together in a nonstop network.

Sol which is a type of colloid in which solid patches are suspended in liquid. When the liquid is faded asemi-rigid mass remains which called a gel. In a gel patches or ions lift before and join together to form a nonstop network. In order to get gel like property significant quantum of fluid need to be removed and this can be fulfilled by sedimentation or centrifugation process. The remaining liquid is removed by using drying process and get dry gel. For this thermal treatment is frequently necessary this may enhance mechanical property of the structure stability. The dried gel is grinded to get fine greasepaint and after that farther process is done by shifting and also get final product. The final product can be deposited on substate to form a film or auto's in to a suitable vessel with asked shape or used to synthesized the greasepaint.

2. Sonochemical synthesis

Pd-CuO nanohybrid was effectively invented by sonochemical fusion with copper salts in the presence of palladium and water. In the presence of palladium & water, ultrasonic energy can be used to convert switching metal salts into oxides. The palladium source is either pure metallic palladium Pd(0) or palladium salts.

3. Hydrothermal synthesis

It is one of the most commonly used manufacturing methods of nanoparticles.Basically,it is an approach that uses chemical reactions.Hydrothermal synthesis covers a wide temperature range from room temperature to very high temperatures for synthesis of nanoparticles. This method has many advantages over the following methods,physical and biological methods. Nanomaterial created hydrothermal synthesis can be unstable at high temperature ranges.

C. Biological method

1. Synthesis using microorganisms

Living entities and inorganic matter have always been in contact with each other since the beginning of life on Earth. Thanks to this regular interaction, life on this planet could be sustained by randomly organized mineral deposits. In recent years, nanoparticle synthesis using microorganisms has become increasingly important due to cost efficiency and environmental considerations. There are two techniques that can be used to synthesize nanoparticles from microorganisms: extracellular biosynthesis and intracellular biosynthesis. Certain microorganisms can separate metal ions. Pseudomonas stuzeri Ag295 is commonly found in silver mines collecting silver inside or outside cell walls.

2. Synthesis using plant extract

The use of plants in the synthesis of nanoparticles is a relatively new field of research compared to the use of microorganisms to produce nanoparticles. There are several examples suggesting that plant extracts can be used for the synthesis of nanoparticles. Here, the extraction of gold nanoparticles from geranium plant extract. Finally, put the crushed life into an Erlenmeyer flask and boil it in water for 1 minute.The leaves are torn and intracellular substances are released. Cool the solution & decant. When added this solution to an aqueous solution of HAuCl,gold nanoparticles began to form within a minute.

7. APPLICATIONS OF NANOPARTICLES:

- **Brain Cancer**

Brain malignant tumors are the most important disease to treat. Brain malignancies are the most difficult to treat due to the limitations of the blood-brain barrier. Brain microvascular endothelium is located at the blood-brain barrier,forming a barrier that distinguishes blood from brain nerve tissue. The BBB prevents harmful toxins,xenobiotics, and other metabolites from entering the brain. Most brain tumors include gliomas and glioblastomas. Both are the deadliest types of brain tumors. The annual incidence is 5.26 per 100,000 people or 17,000 new cases per year.The most common treatments are radiosurgery and chemotherapy, usually temozolomide (TMZ). Nanoparticles have high potential for treating brain tumors due to their small nanometer size,tissue-specific targeting properties,and easy penetration of the blood-brain barrier.

Table 01:- The nanoparticles used in treatment of Brain cancer

NP Name	NP Type	Drug loaded on NP
1. Gold-iron oxide nanocomposites	Curcumin-lipoic acid conjugate	Glutathione
2. Lipid-drug-conjugated nanoparticle	5-FU (flurouracil) nanoparticle	Flurouracil

- **Lung Cancer**

Basically,the lungs are responsible for breathing air.The lungs are made up of airways and alveoli (gas exchange zones). In fact,while the airways are relatively durable barriers to particle penetration,the barriers along the alveolar walls and capillaries within the gas exchange components are relatively weak.Due to the large external surface area of the alveoli and deep air-blood exchange, alveoli health decreases when affected by environmental injuries. Such damage can be the cause of some lung diseases,such as lung malignancies.Several nanoparticles are currently being developed for respiratory applications with the aim of addressing the limitations of conventional drugs.Nanoparticles can help treat many lung diseases such as asthma,tuberculosis,emphysema, cystic fibrosis & cancer.

Nanoparticle	Exposure Method	Used for
1. Lipid polymeric nanoparticles	Intraleritonal injection	Lung carcinoma
2. Hyaluronic-acid-based lipid NP	Dialysis technique used in in-vivo	Lung cancer

Table 02:- The role of nanoparticles used for the treatment of Lung cancer

- **Drug Delivery Approach in Skin Diseases**

Skin diseases include follicular diseases & skin diseases.These skin diseases are currently being treated with nanotechnology. For the treatment of skin diseases,administration of nanoparticles is preferable because it causes fewer side effects. Traditionally used creams,gels,and ointments are not sufficient to deliver the drug due to their poor penetration into the skin tissue. To address this issue,nanocarriers of polymers, lipids,and surfactants are used. Polymer micelles improve drug penetration into skin tissue to treat skin cancer.As on this mentioned study, chitosan polymeric NPs, liposomes,and gold nanoparticles can deal with atopic dermatitis with the aid of using enhancing drug penetration into the dermal and epidermal layers.Gold nanoparticles are extraordinarily small in length and may penetrate effortlessly and correctly with very low toxicity and no pores and skin damage. As such,they're used broadly in nanocarrier formulations for pores and skin diseases.

- **Delivery Approach in Heart Diseases**

Cardiovascular diseases include myocardial infarction (MI), ischemic disorders, coronary artery disease (CAD), arrhythmia, pericardial disease, cardiomyopathy (heart muscle disease), and congenital heart disease. All these diseases are major causes of mortality and morbidity worldwide. Human heart disease involves maladaptations in cardiac position, function, and morphogenesis of myocardial healing and periodic contraction. Liposomes, silica NPs, dendrimers, ceria NPs, micelles, TiO2 NPs, nanocoated stents, microbubbles, and polymer-drug conjugates are used for drug delivery. Magnetic nanoparticles, such as magnetoliposomes (MLs), consist of a combination of liposomes and magnetic nanoparticles. These are used for magnetically targeted drug delivery. Liposomes are used in a variety of ways with various modifications. These are adapted to load drugs into NPs for efficient delivery to cells. Cationic liposomes, perfluorocarbon nanoparticles, polyelectrolyte nanoparticles, and polymeric nanoparticles are modified forms of nanocarriers.

- **Drug Delivery Approach in Blood Diseases**

There are various types of blood diseases,including not only hematopoietic blood diseases but also iron deficiency,leukemia,anemia,hemophilia,platelet diseases & blood cancers. Traditionally used chemotherapy systems damage the immune system and carry a high risk of death. Bone marrow transplantation is also an expensive and complicated process.For example, thalassemia is treated with deferoxamine,a chelating agent used to treat excess iron in the blood. The siRNA-coated nanocomposites have inhibitory effects on tumor cells in vivo.Treatment of blood diseases with nanomedicine is still under research.

- **Drug Delivery Approach in Bone Diseases**

Bone diseases include bone defects due to many pathological factors such as fractures, trauma, osteoporosis,arthritis,infections and many other diseases. In fact,bone regeneration as a disease treatment is a highly complex process that fuses nanomaterials and biomaterials to effectively repair bone. Through the combination of biomaterials & nanomaterials,the development of bone bioscaffolds has reduced bone grafting.

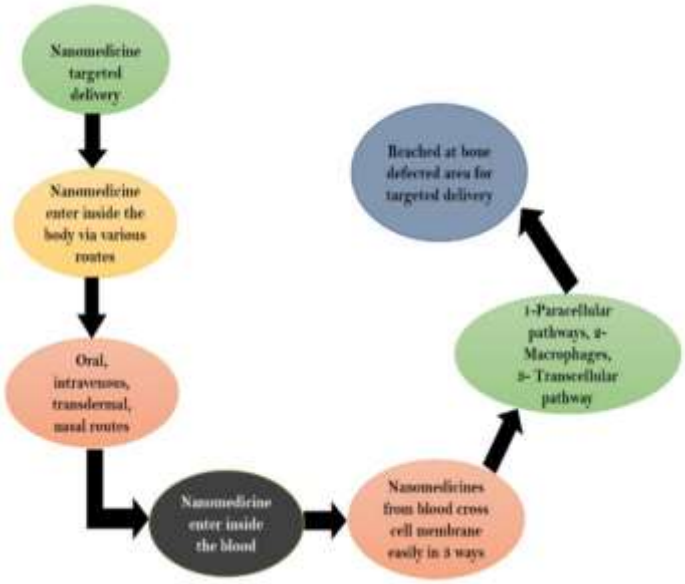

Fig. 02: Mechanism of Drug Delivery in bone disease

8.DRUG RELEASE

When developing nanoparticle delivery systems, it is important to consider both drug release and polymer biodegradation. In general, the rate of drug release depends on: (1) the solubility of the drug; (2) Desorption of drugs bound or adsorbed to the surface. (3) Diffusion of drug through the nanoparticle matrix. (4) Erosion or degradation of the nanoparticle matrix. (5) A combination of erosional and diffusion processes. Therefore, the solubility of the particle matrix and the biodegradation of the diffusion band determine the release process. In the case of nanospheres in which the active ingredient is homogeneously distributed, the release of the active ingredient occurs through diffusion or erosion of the matrix. When drug diffusion occurs faster than matrix erosion, the release mechanism is primarily controlled by the diffusion process. The initial rapid release or "excretion" is believed to be primarily due to the drug being weakly bound or adsorbed to the relatively large surface area of the nanoparticles (Magenheim et al., 1993). It is clear that the method of ingestion influences the release profile. When nanoparticles are coated with polymers, release is controlled by diffusion of the drug from the polymer membrane. The membrane coating acts as a barrier to drug release. Therefore, drug solubility and diffusion in or through polymer membranes are critical factors for drug release. Various methods can be used to study drug release from nanoparticles. (1) Adjacent diffusion cells with artificial or biological membranes. (2) Dialysis bag diffusion. (3) Reverse dialysis bag diffusion. (4) Stirring followed by ultracentrifugation/centrifugation. or (5) ultrafiltration. Release studies are typically performed by controlled agitation followed by centrifugation. Dialysis techniques are generally preferred due to the time and technical difficulties required to separate the nanoparticles from the release medium. However, these methods have proven difficult to reproduce or scale for industrial applications.

9.DELIVERY AND RELEASE, MECHANISM OF NANOPARTICLES

An ideal medicine delivery system should have effective targeting and controlled release. The two main targeting strategies are unresistant targeting and active targeting. Passive targeting depends on the fact that excrescences have abnormally structured blood vessels that favor accumulation of fairly large macromolecules and nanoparticles. This so called enhanced permeability and retension effect (EPR) allows the medicine-carrier be transported specifically to the excrescence cells. Active targeting is, as the name suggests, much more specific and is achieved by taking advantage of receptor- ligand relations at the face of the cell membrane. Controlled medicine release systems can be achieved through several styles. Rate programmed medicine delivery system are tuned to the diffusivity of active agents across the membrane. Another delivery- release medium is activation- modulated medicine delivery, where the release touched off by environmental stimulants. The stimulants can be external, similar as the preface of a chemical activators or activation by light or electromagnetic fields, or natural-similar as pH, temperature, and bibulous pressure which can vary extensively throughout the body.

10.CONCLUSION

There's no mistrustfulness that nanotechnologies have helped to ameliorate the quality of life of cases by furnishing a platform for advances in biotechnological, medicinal and pharmaceutical industries.Now a days, medicine targeted delivery through nanoparticles is catching the attention of pharmaceutical experiments each over the world. Nanomedicine will overcome all the side goods of traditional medicines.Nano delivery systems hold great eventuality to overcome some of the obstacles to efficiently target a number of different cell type. This represents an instigative possibility to overcome problems of medicine resistance in target cells and to grease the movement of medicine across walls(e.g.BBB). The challenges, still, remains

the precise characterization of molecular targets and make sure that these molecules only affect targeted organs. A full lifecycle evaluation is needed to more directly ascertain the sustainability and safety of their use long term.

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