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A Review on Nanoparticle

Abhishek Borkar[1],Gopal Kharbal[2],Manasvi Shende[3] , Payal Gaikwad[4], Shubhda Bhopale [5]

Shraddha Institute of pharmacy Kondala Zambre washim-444505

Shraddha Institute of pharmacy Kondala Zambre washim-444505

Corresponding Author: Abhishek Borkar

Address: Shraddha Institute of pharmacy Kondala Zambre washim-444505

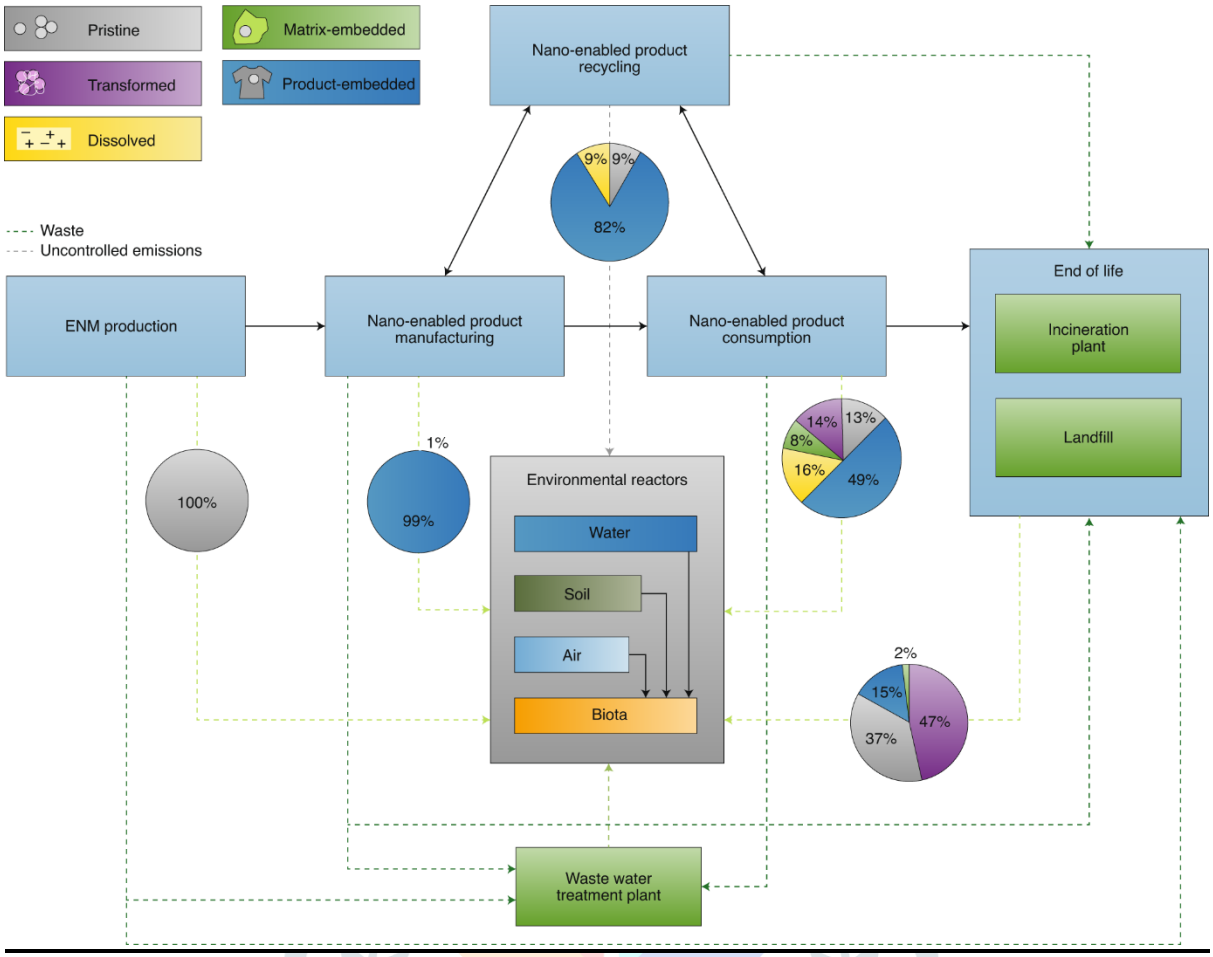
Abstract: Nanomaterials have emerged as an amazing class of materials that consists of a broad spectrum of examples with at least one dimension in the range of 1 to 100 nm. Exceptionally high surface areas can be achieved through the rational design of nanomaterials. Nanomaterials can be produced with outstanding magnetic, electrical, optical, mechanical, and catalytic properties that are substantially different from their bulk counterparts. The nanomaterial properties can be tuned as desired *via* precisely controlling the size, shape, synthesis conditions, and appropriate functionalization. Generally nanoparticles size ranges from 1 to 100 nm with one (or) more dimensions. Generally nanoparticles classified into inorganic, organic and particles based on carbon in nanometric scale that has properties improved compared to larger size of respective materials. They show properties which are enhanced such as strength, sensitivity, high reactivity, stability, surface area etc., due to their smaller size. They were synthesized by various methods for research and commercial uses which are classified into three types-chemical, physical and mechanical processes which had sawn a vast improvement. We have prepared this paper to present a review on nanoparticles, their types, characterization, synthesis methods and applications in field of environment.

KEYWORDS: Nanoparticles, types, synthesis, characteristics and applications

INTRODUCTION:

Nanotechnology is the act of purposefully manipulating matter at the atomic scale, otherwise known as the "nanoscale." In Pharmacy its all about synthesizing, characterizing and screening the particle at Nano range. Nanoparticles are the fundamental components of Nano technology. Nano particles size ranges from 1 to 100nm which are made up of metal, metal oxides, organic matter, carbon. Nanoparticles differ from various dimensions, to shapes and sizes apart from their material. Surface can be irregular with surface variations or a uniform. Among nanoparticles some are crystalline or amorphous with single or multi-crystal solids either agglomerated or loose. In the process of synthesizing new drugs, most drug candidates are insoluble or poorly soluble in water which causes a huge downfall for the pharmaceutical industry.

Principle :



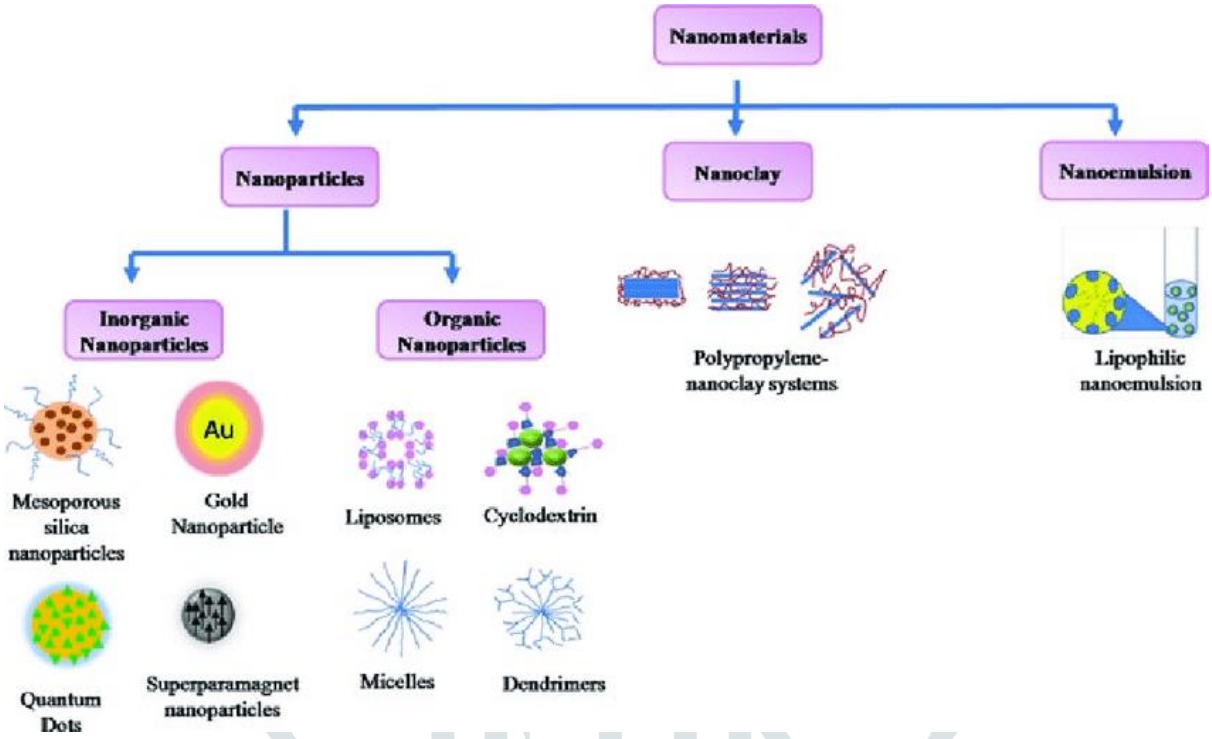
ADVANTAGES OF NANOPARTICLES:

1. Site-specific targeting is often achieved by attaching targeting ligands to the surface of particles.
2. Drug release can be controlled or sustained which will increase the therapeutic efficacy of a drug.
3. Side effects and toxicity shall be reduced.
4. Passive and active drug targeting can be easily achieved by manipulating surface and particle size characteristics.
5. Both hydrophilic and hydrophobic drug can be easily delivered.
6. It can be administered through different routes like oral, nasal, parenteral.

DISADVANTAGES:

1. The cost of manufacture is high and encapsulation efficiency is less.
2. The solvent system used during the preparation process may produce toxicity.
3. Particle aggregation and physical handling of nanoparticles in dry and liquid form are difficult.
4. Leakage and sudden release of the drug may be one of the critical problems.
5. The higher surface to volume ratio makes the particles more reactive or catalytic.

Classification-of-nanomaterial



Mechanisms of Drug Release:

The drug from the polymeric drug carriers deliver at the site of the tissue by anyone of the three general physico-chemical mechanisms which are explained below:

1. By hydration which causes the swelling of the polymer nanoparticles followed by release through diffusion.
2. By an enzymatic reaction that leads to rupture or degradation or cleavage of the polymer at the site of delivery and results in the release of the drug from the entrapped inner core.
3. Dissociation of the drug from the polymer and it does de-adsorption/release from the swelled nanoparticles.

Polymer Used for the Preparation of Nanoparticles:

Polymers based nanomaterials are the vehicles for control release of the drug, in which drug can be either adsorbed on their surface or entrapped inside. Polymers utilized in preparation of nanoparticles should be biocompatible and biodegradable. It can be either from natural source or synthetic source[4,5,6]. List of polymers can be ulilized are given below:

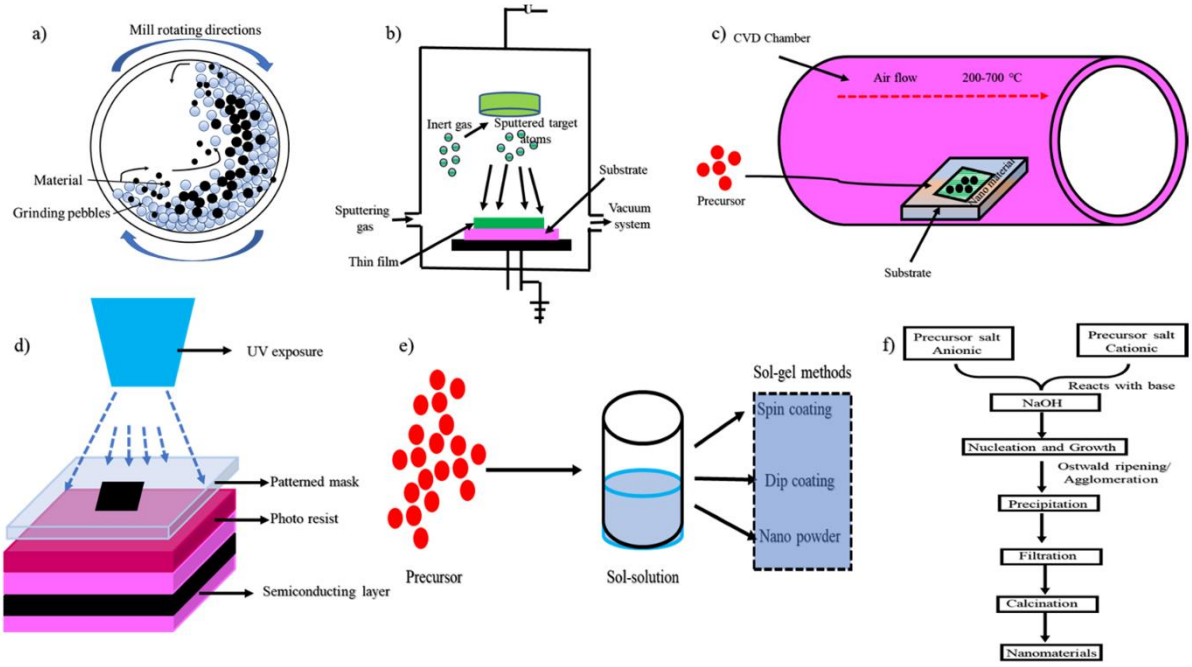
· **Natural polymers**

a) Chitosan
b) Gelatin
c) Alginate

· **Synthetic polymers**

a) Poly lactide (PLA)
b) Poly acrylate
c) Poly mathacrylate
d) polycaprolactones
e) Poly lactide-co-glycolide (PLGA)

Synthesis of nanoparticles :



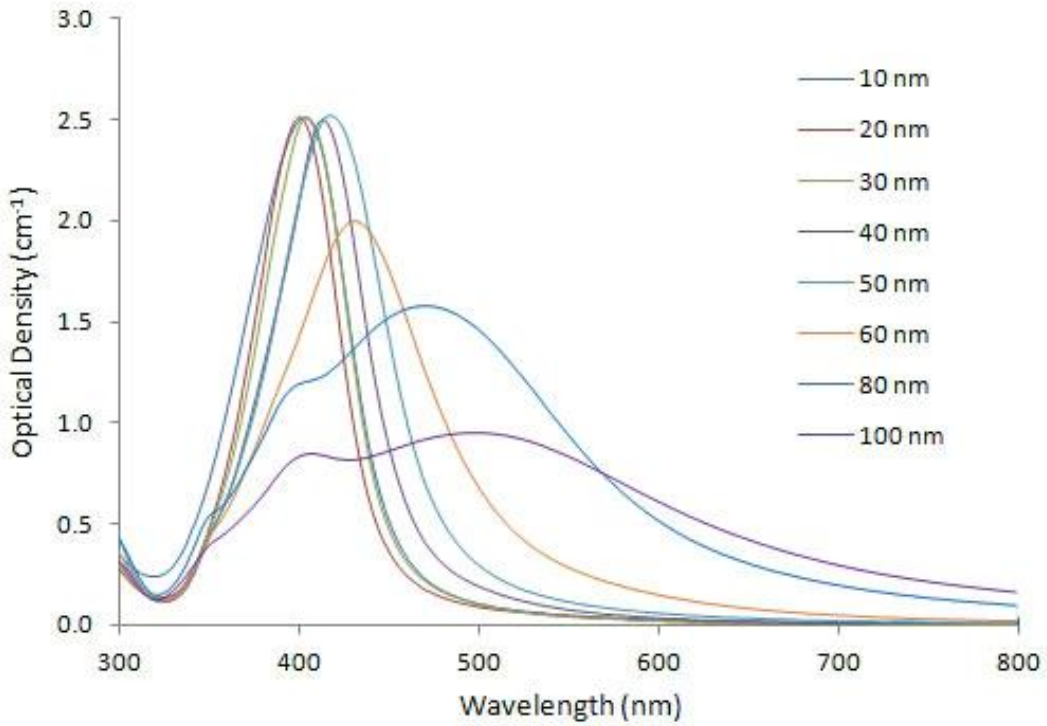
Benefits :

- ✓ Easily pass through the smallest capillary
- ✓ Easily penetrate cells ,tissue.
- ✓ Avoid rapid clearance by phagocytes
- ✓ Shows controlled release property.
- ✓ Site specific targeting
- ✓ Easy administeration by various routes
- ✓ Reduced toxicity

Toxicity of NP

Beside many industrial and medical applications, there are certain toxicities which are associated with NPs and other nanomaterials (Bahadar et al., 2016, Ibrahim, 2013, Khlebtsov and Dykman, 2011, Khlebtsov and Dykman, 2010b) and basic knowledge is required for these toxic effects to encounter them properly. NPs surreptitiously enter the environment through water, soil, and air during various human activities. However, the application of NPs for environmental treatment deliberately injects or dumps engineered NPs into the soil or aquatic systems. This has resultantly attracted increasing concern from all stakeholders. The advantages of magnetic NPs such as their small size, high reactivity and great capacity, could become potential lethal factors by inducing adverse cellular toxic and harmful effects, unusual in micron-sized counter parts. Studies also illustrated that NPs can enter organisms during ingestion or inhalation and can translocate within the body to various organs and tissues where the NPs have the possibility to exert the reactivity being toxicology effects. Although some studies have also addressed the toxicological effects of NPs on animal cells and plant cells the toxicological studies with magnetic NPs on plants to date are still limited. The uses of Ag NPs in numerous consumer products lead them to their release to the aquatic environment and become a source of dissolved Ag and thus exert toxic effects on aquatic organisms including bacteria, algae, fish and daphnia The respiratory system represents an unique target for the potential toxicity of NPs due to the fact that in addition to being the portal of entry for inhaled particles, it also receives the entire cardiac output NPs are used in bio applications widely but despite the rapid progress and early acceptance of nanobiotechnology the potential for adverse health effects due to prolong exposure at various concentrations levels in human in the environment has not yet been established.

Graph :



APPLICATION:

A nanoparticle has great prospects for the diagnosis and treatment of diseases. It has been widely employed for different therapeutic applications, some of which are listed below:

a. Nanoparticles are reported to effectively combat against intracellular infections of the human body.
b. Nanoparticles can effectively deliver chemotherapeutics drugs with reduced toxicity and increase therapeutic activity.
c. Nanoparticles are successfully served the purpose of drug targeting to specific areas with minimum side-effects.
d. Nanoparticle systems can improve the delivery of the drug to eyes through the increase retention time.
e. It can be used as carriers for radio nucleotides for diagnostic purposes.
f. It is very useful for improving the solubility and bioavailability of poorly soluble drugs and protects the drug from gastrointestinal enzymes.
g. Solid nanoparticles are useful for hair and skin care therapy.
h. Nanoparticle drug delivery systems can effectively deliver drugs across the blood-brain barrier (BBB).

CONCLUSION :

The foregoing discussion shows that nanoparticulate systems have great potentials, being able to convert poorly soluble, poorly absorbed and labile biologically active substance into promising deliverable drugs. The core of this system can enclose a variety of drugs, enzymes, genes and is characterized by a long circulation time due to the hydrophilic shell which prevents recognition by the reticular-endothelial system. To optimize this drug delivery system, greater understanding of the different mechanisms of biological interactions, and particle engineering, is still required. Further advances are needed in order to turn the concept of nanoparticle technology into a realistic practical application as the next generation of drug delivery system.

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