



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Article Review On Nanoparticles

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Abstract:

Nanoparticles are the part of Novel Drug Delivery System (NDDS) that play a key role to produce prolong release of drug .There are many types of Novel drugs introduced for prolong release¹. The Novel drugs have a advantage of rapid action and have a sustain release of the drug and they reduce the toxicity of the drug. There are many types of novel drugs in the form of Nanoparticles, Misospheres, Lipososomes, Niosomes, Hydrogels, Transdermals, Dentrimeres, Ethosomes, Phytosomes, Liquid Crystals. Nanoparticles are the small spherical particles which have the size range in 10 to 500 nm². These Nanoparticles are made by which the drug is enclosed in a polymeric material³. The polymer may be a natural polymer or an artificial polymer. Nanoparticles show the targeted action⁴. Nanoparticles have high surface area that allows the heat, molecules and ions to pass in or out at a vey high rate that cause rapid action at the targeted site. Nanoparticles are used in diagnostic tests and also used in treatment of various diseases such as cancers, Alzimer's diseases, lung disease, diabetes , CVS and also in gene therapy.⁵

Key words:

Nanoparticles, Novel drug delivery, Sustained relese, Targeted Delivery, Polymeric Nanoparticles, Nanotechnology⁶.

Introduction:

Nanoparticles is a part of Nanotechnology. The nanotechnology plays a key role in designing , production and also in characterization of nano sized particles. Human body is composed of various types of cells and the cells are also in nano sized so Nanotechnology is being introduced to overcome the problems related to targeting the drugs at their site of action⁷. Nanoparticles mainly attributes to particle surface area, surface charge and also on the size that have a main effect on the drug delivery system. They have a different physicochemical properties a such as High Potency , Low toxicity ,High Therapeutic activity⁸. Some macromolecules such as peptides and proteins have stability issues so in order to overcome such problems they are encapsulated in the form of nanoparticles that are enclosed in the polymer as they cannot be administered through oral route and in order to overcome some issues related to gastrointestinal enzymes and also some limitations such as liver bypass⁹. Presently Nanoparticles are used in delivering the drugs that have low solubility, poor bioavailability and in order to achieve high Pharmacokinetic effect. Some other properties of nanoparticles is that they require very less excipients in their formulation, they have simple preparation procedures, have high physical stability and can be mainly used for chronic treatment of a disease¹⁰.Now a days nanoparticles are mainly act as a chemotherapeutic agent in treatment of cancers such as Breast cancer, Liver cancer, lung cancer etc¹¹..

Types of Nanoparticles:

Nanoparticles may be classified as

Polymeric based: Dendrimers, Nanoparticles, Micelles, Drug conjugates, Protein Nanoparticles¹².

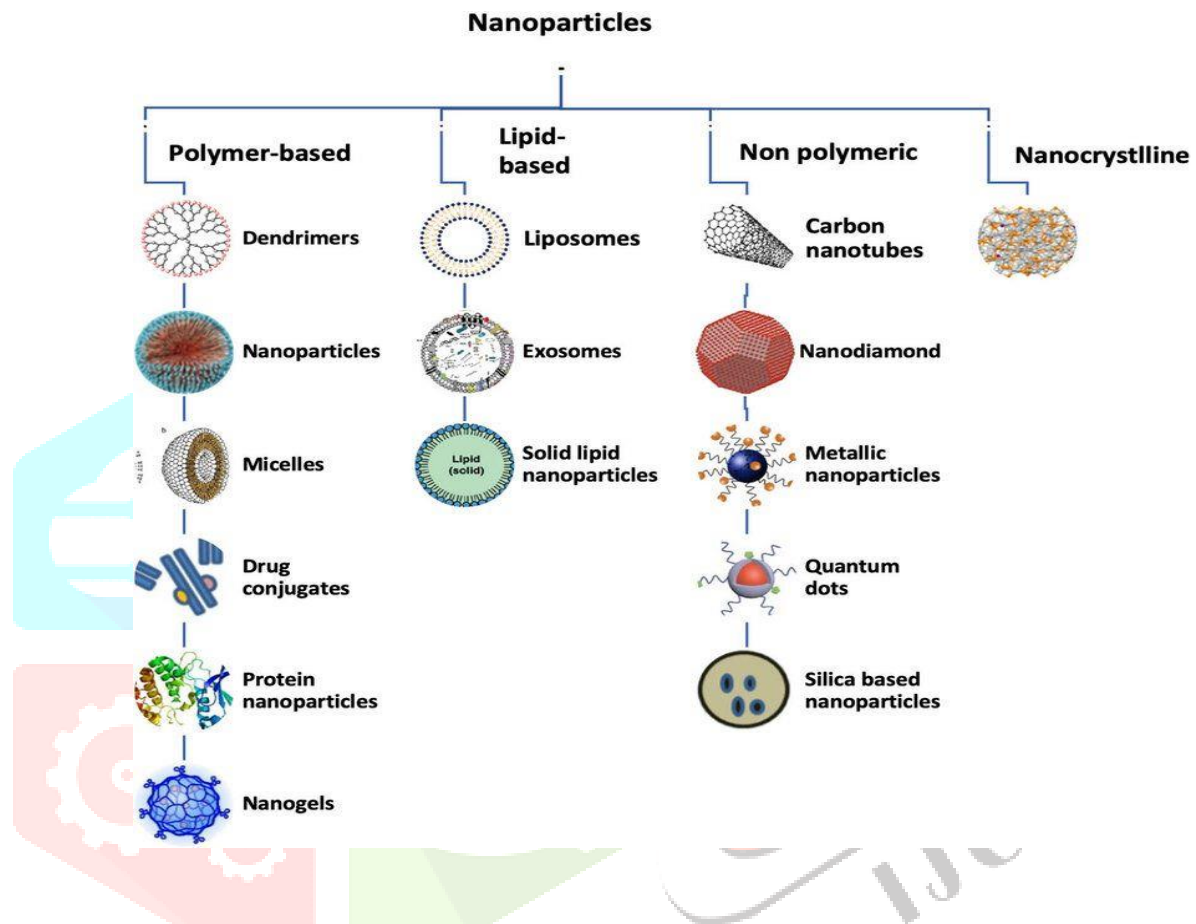
Lipid based: Liposomes, Exomers, Solid lipid nanoparticles¹³.

Non polymeric: carbon nanoparticles, nanodiamond, metallic nanoparticles, quantum dots, silica based nanoparticles¹⁴.

Nanocrystalline

Organic : Polymeric nanoparticles, polymeric micelles, polymersome.

Inorganic nanoparticles: silver nanoparticles, iron oxide nanoparticles, gold nanoparticles, calcium phosphate nanoparticles, mesoporous nanoparticles¹⁵.



Classification of nanoparticles

Advantages of Nanoparticles:

As the nanoparticles increases the solubility Lipophilic drugs are used and they dissolved fastly¹⁶.

The nanoparticles have tunable physical and chemical properties¹⁸.

They have the targeted drug delivery¹⁷.

They have high biocompatibility and also have high bioavailability of drug.

They are highly biodegradable¹⁹.

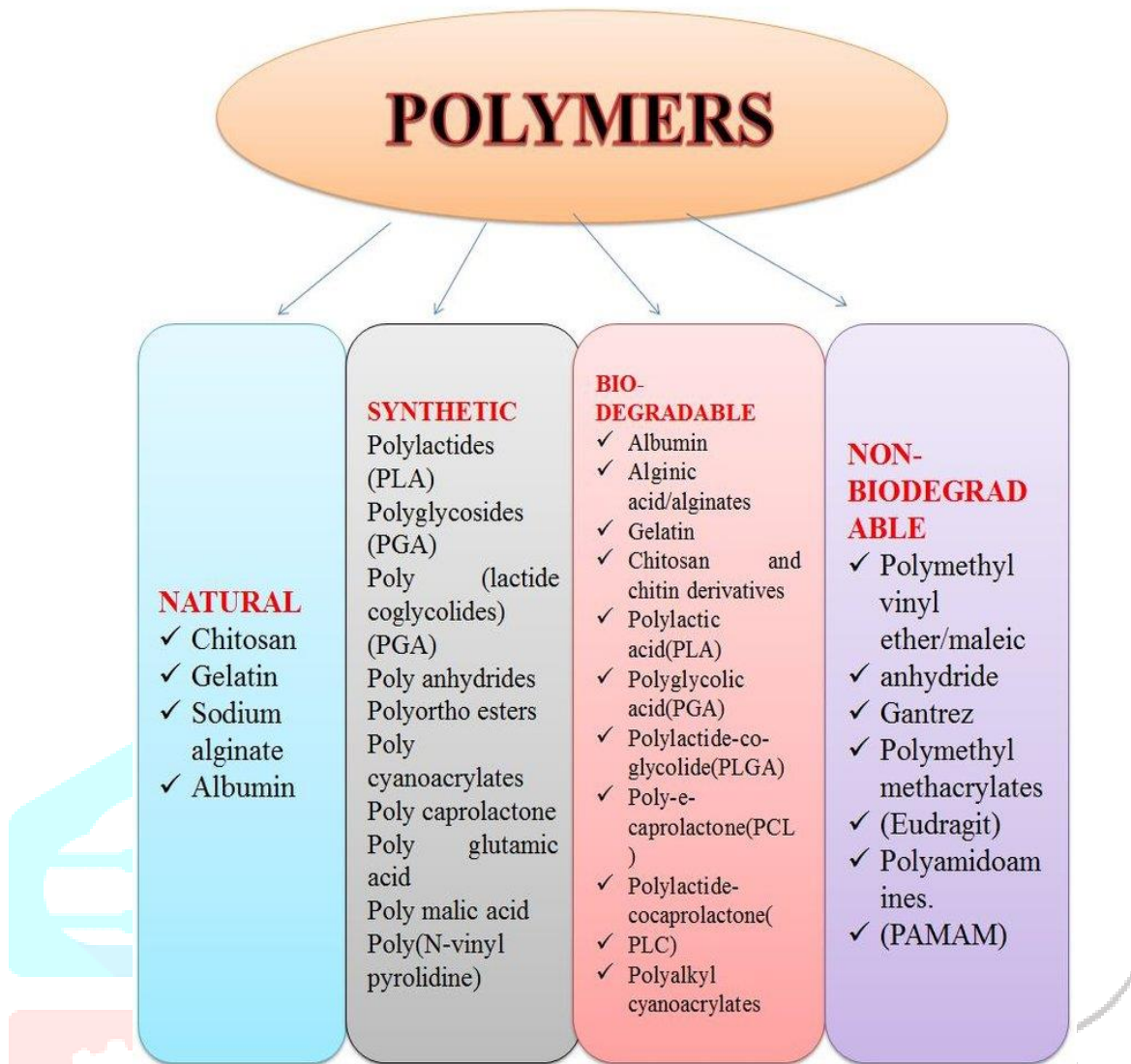
They have low toxicity and low side effects of the drugs.

Disadvantages of Nanoparticles:

They possess unpredictable genotoxicity due to insufficient toxicological assessment studies.

They are more expensive²⁰.

They possess short shelf life²².



Types of polymers used in Nanoparticles

Methods of Preparation of Nanoparticles:

There are various methods for preparation of Nanoparticles such as:

- **Desolvation** : The desolvation method is carried out by the process in which the nanoparticles are prepared when the desolving agent such as alcohol or acetone is added dropwise to an aqueous solution of protein by continuous stirring due to this the dehydration of proteins occurs that results in conformational changes from stretched to conformation⁴¹. This process requires hydrothermal energy as the temperature changes from room temperature to high temperature for the synthesis⁴².
- **Dialysis** : In this method the drug and the polymer are dissolved in the organic solvent and then this solution is placed in the dialysis tube and then the dialysis is performed and after purification of the suspension the nanoparticles are prepared²¹.
- **Nanoprecipitation**: In this method the drug and the polymer are dissolved in the organic phase and then the mixture is emulsified in the aqueous phase the displacement of organic phase occurs²³ and complete miscibility of both faces occurs and forms precipitation after centrifugation of precipitate the nanoparticles are prepared²⁴.
- **Solvent Evaporation**: In this method the drug and the polymer are dissolved in the organic solvent then the mixture is emulsified with an aqueous phase that contains surfactant⁴⁵. Due to this the O/W type of emulsion is obtained²⁵. Then the organic phase is then evaporated. This results in the formation of nanoparticles²⁶.

- **Salting out :** The drug and the polymer are dissolved in the (acetone) organic phase and the stabilizer and salting out agent is dissolved in the aqueous phase²⁷. As the acetone diffuses in the aqueous phase this results in formation of nanoparticles²⁸.
- **Spray Drying :** the drug and the polymer dissolved in the organic solvent this mixture is introduced into the drying chamber of the spray automiser and the adequate amount of heat is supplied by spraying and results in the formation of nanoparticles²⁹.
- **Supercritical fluid:** A super critical fluid such as carbon dioxide is used along with high heat and pressure. when the supercritical point is obtained the carbon dioxide gas changes to liquid due to this the substance introduced to form nanoparticle is dissolved in the supercritical carbon dioxide³⁰. This results in formation of nanoparticles.

Evaluation tests for nanoparticles: The evaluation tests for Nanoparticles include:

Yield of Nanoparticles : The yield of nanoparticles is determined by comparing the whole weight of nanoparticles formed against the combined weight of copolymer and drug³¹

$$\% \text{ yield} = \frac{\text{amount of nanoparticle}}{\text{amount of drug} + \text{polymer}} \times 100$$

Particle size and Zeta potential : Value of Particle size and Zeta Potential prepared nanoparticles determined by using Malvern Zetasizer³².

Drug content/ surface entrapment :

After centrifugation amount of drug present in supernatant(w) determined by UV Spectrophotometry.

After that standard calibration curve plotted³³.

Then amount of drug present in supernatant subtracted from the total amount used in the preparation of nanoparticles (W). (W-w) is the amount of drug entrapped³⁴.

$$\% \text{ drug entrapment} = \frac{W-w}{W} \times 100$$

The withdrawn samples were analyzed using UV spectrophotometer

Surface Morphology: Surface morphology study carried out by Scanning Electron Microscopy (SEM) of prepared nanoparticle³⁵.

Poly disperity index : Polydispersity index of prepared nanoparticles was carried out by using Malvern Zetasizer³⁶.

In – vitro release study : In-vitro drug release studies were performed in USP Type II dissolution apparatus at rotation speed of 50 rpm³⁷.

The prepared immersed in 900ml of phosphate buffer solution in a vessel, and temperature was maintained at $37 \pm 0.20^\circ\text{C}$ ³⁸.

Required quantity 5ml of the medium was withdrawn at specific time periods and the same volume of dissolution medium was replaced in the flask to maintain a constant volume³⁹.

Stability of Nanoparticles :

Stability studies of prepared nanoparticles determined by storing optimized formulation at $4^\circ\text{C} + 1^\circ\text{C}$ and $30^\circ\text{C} \pm 2^\circ\text{C}$ in stability chamber for 90 days.

- The samples were analyzed after a time period like at 0, 1, 2, and 3 months for their drug content, drug release rate (t50%) as well as any changes in their physical appearance⁴⁰.

Conclusion:

The nanoparticles have a greater advantages of having good physicochemical properties such as size , solubility and targeted delivery but all the nanoparticles are prepared by chemical methods only that results to high expenditure for its preparation in order to this the nanoparticles are highly expensive⁴³. To overcome this problem furthure technology should be introduced to prepare the nanoparticles by natural process such as herbal methods and other methods that are cost effective so that the nanoparticles can be effectively used as a part of Novel Drug Delivery System⁴⁴.

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