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REVIEW ON NANOPARTICLES AS NOVEL DRUG DELIVERY SYSTEM

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Abstract.

Nanoparticles are Defined as Particulate Dispersion and ligand Mediated in Nano System. The Several Technique are Used in Precipitation of Nanoparticles like Solvent Evaporation.

Double. Emulsification method, Emulsion Diffusion. Nanoprecipitation salting out, dialysis, supercritical fluid technology method.

Index terms

Salting Out Method. SCF (Super Critical Fluid Technology) SAS (super critical Anti solvent) RESS (Rapid Expansion Critical Solution) SEM (Scanning Electron Microscope TEM (Transmission Electron Microscope).

Introduction.

Nanoparticles are define particulate dispersion or solid particles drug carrier may or may not biodegradable [1].The nanoparticles is term Depends on Combined in Nano Sphere and Nanocapscule. The Nanoparticles Different from Various Dimensions to Shape and Size .The Nanoparticles is Used in Every Obvert like Cooking Vessel, Electronic to Renewable Energy and Aerospace Industry . This are method are modified in specific nanoparticles such as Optical, Mechanical and Physicochemical Properties.[2]. The International Systems of Nanotechnology is Typically Measured in Nanometre Scale at one Billionth of Meter [1].The surface is uniform or Irregular Surface Variation. some nanoparticles are crystalline and amorphous with single or multi crystal solid [3]. Nanoparticles are colloidal particles with diameter ranging in 1 to100nm [4]. The relatively of large surface area to volume is increase in relatively or stability in chemical process is enhanced In mechanical strength [40].

Advantage of Nanoparticles

1.The targeted drug carrier nanoparticles reduce drug toxicity and enhanced efficient drug distribution.[5]
2.Polymer drug relse form nanoparticles can be modified in polymeric nanoparticles in ideal drug delivery systems.[6]
3.It's useful diagnosis in various disease.
4.Enhanced stability of ingredient.
5.Prolonged self life.

Disadvantages of Nanoparticles

1.Poor drug loading capacity
2.Low hydrophilic drug loading capacity due to portioning effect.
3.Heigher water content.
4.Burest release take place.
5.Physically instable.

Application of Nanoparticles

1.The bio detection of pathogens.
2.Detection of protein.
3.Tissue engineering.

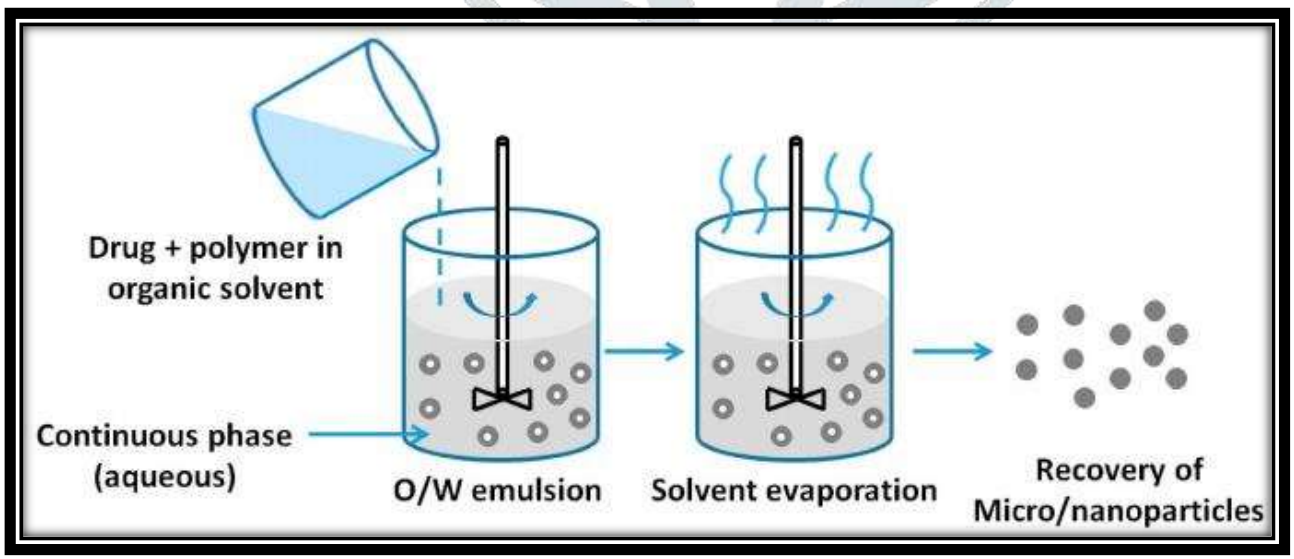
4.Phagokinatic studies.
5.Drug and gene therapy.
6.Probing of DNA structure.
7.MRI contrast enhancement [5].
Uses of Nanoparticles
1.Its used in manufacturer of scratchproof eyeglasses.
2.Its used in crack resistant patients.
3.Its used in anti-graffiti coating for wall.
4.Its used in transparent sunscreen.
5.Its used in stain repellent fabrics.
6.Its used in self cleaning windows and ceramic coating for solar cell.
7.The nanoparticles contribute stronger lighter, cleaner and smarter surface and system.
Method of Preparation of Nanoparticles
1.Solvent Evaporation
2.Spontaneous Emulsification
A.Double Emulsification
B.Nanoprecipeation
C.Salting Out Method
D.Dialysis
E.Supercritical Fluid Technology
F. Coacervation or Ionic Gelation Method
G. Polymerization Method
1.Solvent Evaporation

In this method are Polymer dissolved in organic solvent such as Dichloromethane, chloroform, ethyl acetate [6].The mixture of polymer and drug solution is than emulsified in aqueous solutions containing surfactant and emulsified agent to O/W emulsion after formations of stable emulsion.

Polymer+Drug [organic solvent]
↓ Aq. Solution
Stabilizer in Water
↓ Solvent Evaporation
Formation of nanoparticles

In this step first dissolved in polymer and drug dissolved in organic solvent such as stabilize in water with the help of Aq. Solution than the containing the stabilized in water to a formations of nanoparticles with the help of solvent evaporation.

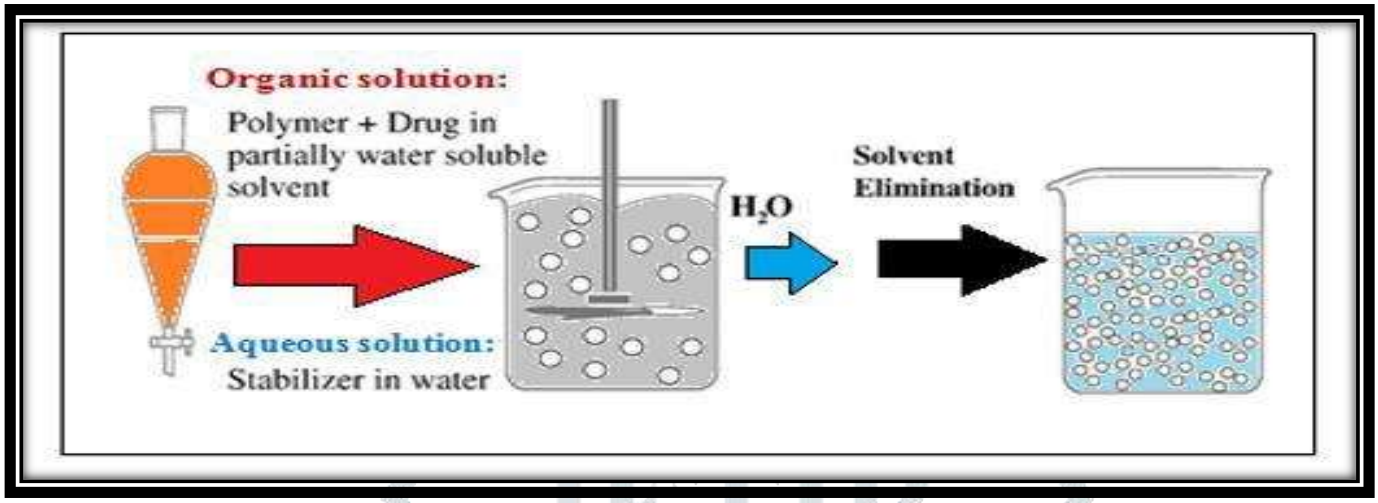
[Fig No 1. Solvent Evaporation method]



2.Spontaneous Emulsification or solvent diffusion method

This method potent by laureate it modified form salting out method. The Polymer and drug dissolved soluble in solvent this solution are saturated with water this phase are emulsified in aqueous solution containing stabilization than solvent removed by evaporation and solvent diffusion method.[7]

[Fig No 2. Spontaneous Emulsification or Solvent Diffusion Method]



[Organic Solution]
Polymer and drug dissolved in solvent
Aq.solution
Stabilizer in Water
Addi. Of water. Solvent Evaporation
Formation of nanoparticles

The organic Solution such as Polymer and Drug dissolved in solvent such as stabilize in water with the help of Aq. Solution than the another way of water stabilization is a addition of excess amount of water to formation of nanoparticles with the help of solvent evaporation.

Advantage

1.This method are high encapsulation 70%.
2.This method are homogenization
3.This method are high batch to batch reproducibility

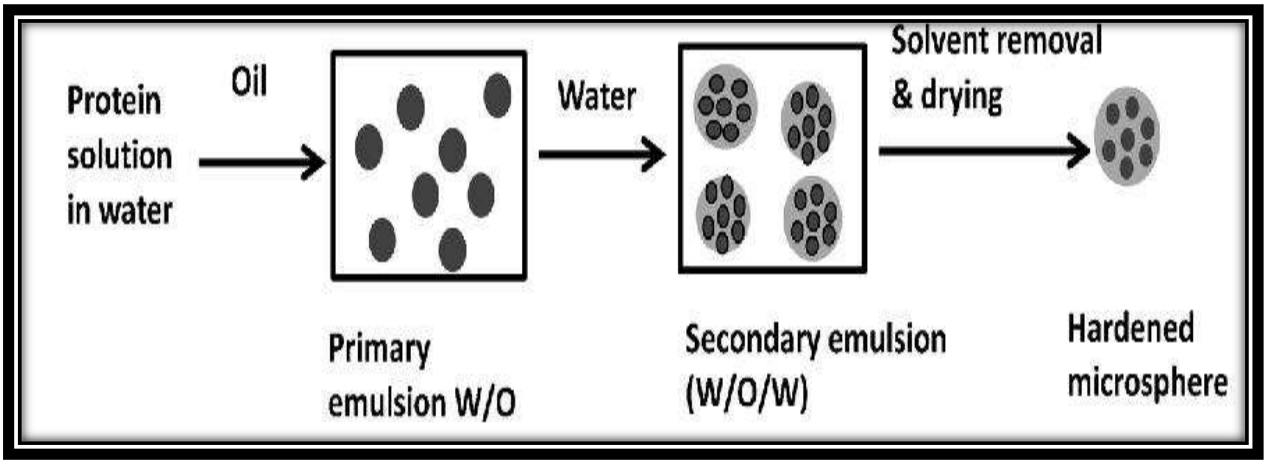
Disadvantages

1.This method are high volume of water to be eliminate form suspension
2.This method are reduced in encapsulation efficiency [8.9.10].

A. Double Emulsification method

Emulsification and Evaporation method have limitations of poor entrapment and hydrophilic drug. The O/W emulsion prepered by addition of Aq. Drug solution to organic Polymer Solution with continuous stirring than prepered emulsion another Aq. Phase with vigorous stirring than resultant in multiemulsion W/O/W prepered than organic solvent removed in high centrifugation [1].

[Fig No 3. Double Emulsification method]



Solution of O/W emulsion

↓ Addition of Aq. Solution

Organic Polymer Solution

↓

Than another organic Solution prepered

↓

Emulsion in another aq. Phase

↓

Multiemulsion that organic solvent [W/O/W]

↓

Formation of Nanoparticles

The prepared of O/W emulsion solution in this solution of hydrophilic drug solution. The solution of O/W emulsion is prepared in organic Polymer Solution with the help of addition in Aq solution than another organic solution prepared to a another emulsion in Aq. Solution to a formations of multiemulsion [W/O/W] than the Formation of nanoparticles.

B. Nanoprecipitation Method

This is method widely used in nanoparticles preparation also called solvent displacement. This technique was first described by fess at ol 1989.[6.10]. This method precipitation of Polymer and drug obtained from organic solvent diffused in aqueous medium with or without presence of surfactants [6].

[Organic Solution]

Polymer+Drug+Surfactant

↓ Aq. Solution

Stabilizer in Water surfactant

↓ Solvent and water Evaporation

Formation of nanoparticles

In this method are firstly dissolved in organic solution such as polymer+ drug+ surfactant is mixture of polymer solution are dissolved. In this solution Stabilizer in water with the help of Aq. Solution than Stabilizer in Water surfactant is solvent evaporation than the formation of nanoparticles.

[Fig.No.5.Nanoprecipitation Method]

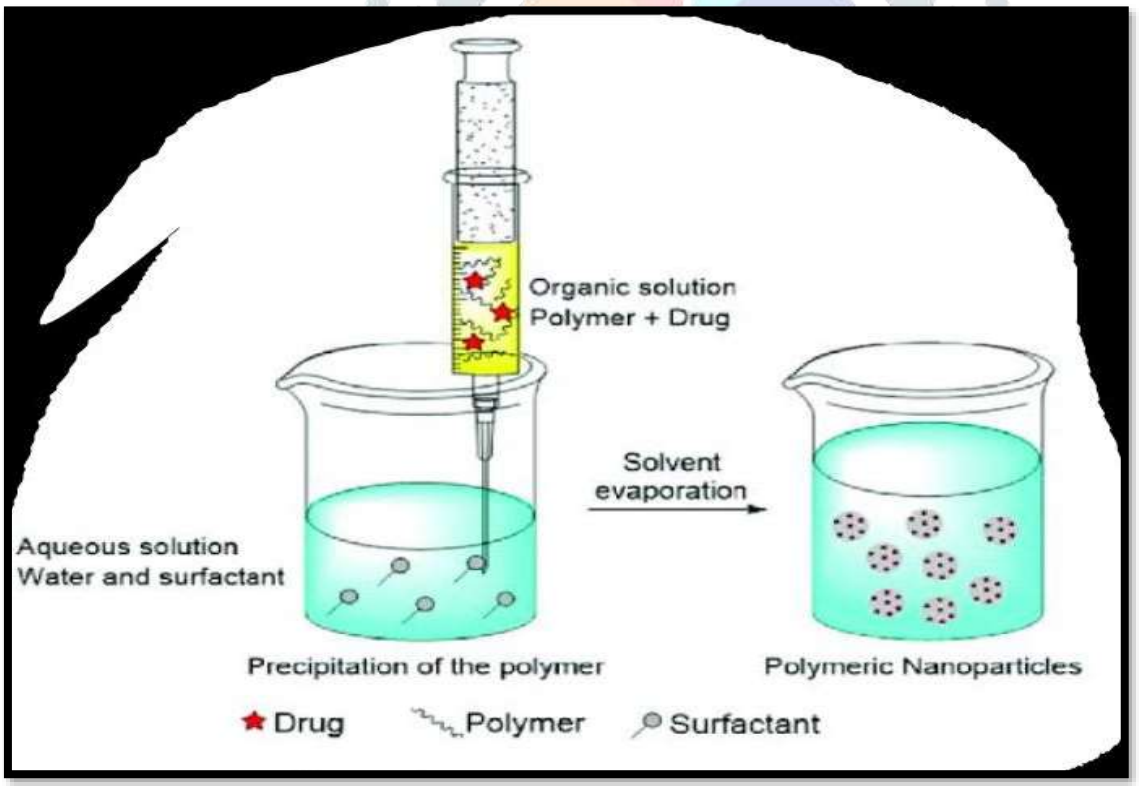


Diagram consideration of Nanoprecipitation Method.

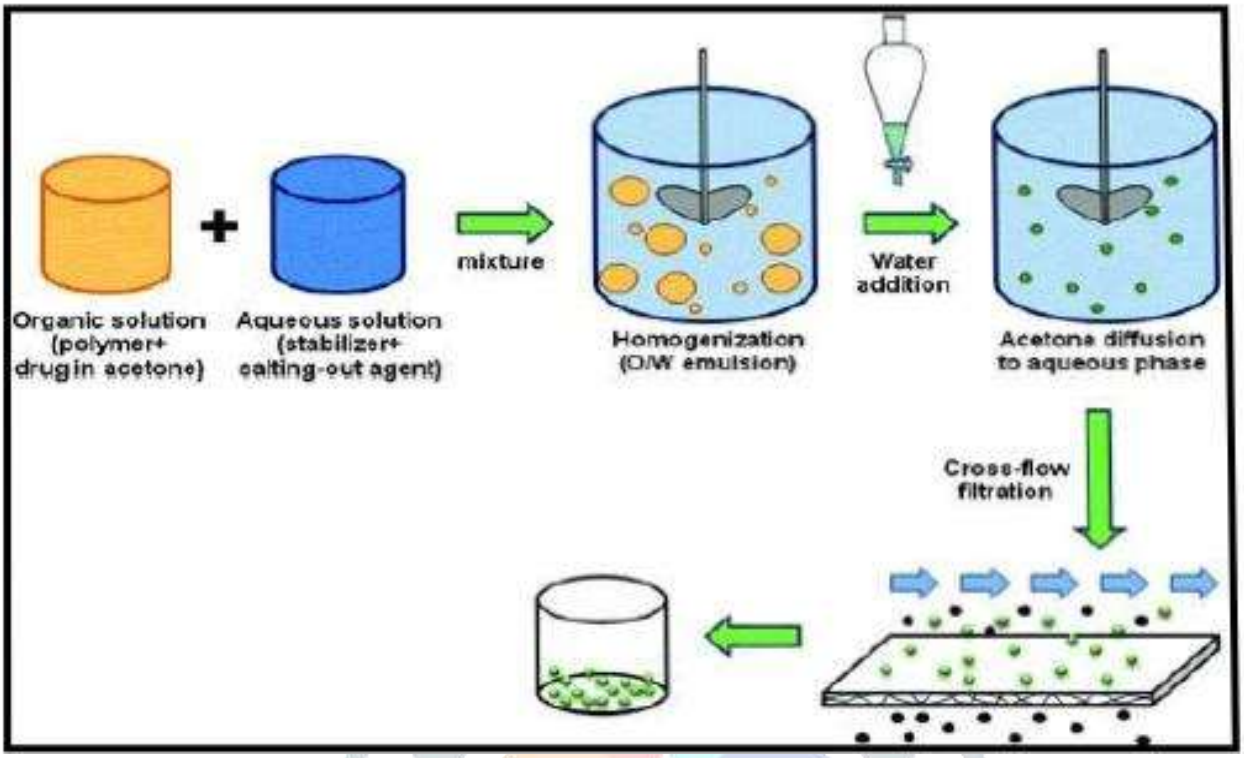
The firstly drug dissolved in water and cosolvent is added in this solution than another solution of polymer and propylene glycol with chloroform prepered this solution dispersed in drug solution.

The dispersion slowly added in 10mlof 70% aq. Ethanol solution with 5 minutes mixing than the organic solvent removed in 35° under normal pressure than nanoparticles are separated in cooling centrifugation (10000 rpm in 20 minutes) than removed and nanoparticles washed in water and dried at room temperature in desiccator [41].

C. Salting out method

This technique introduce in genetic makeup and the genetic changes in the cancer cells el Al and Ibrahim et al. This technique based on separation of water miscible solvent form Aq solution by salting out effect. The Polymer and drug dissolved in solvent which emulsified into aq. Solution containing salting out method. This technique does not required in increase in temperature and stirring energy required for lower particles size [8.10.11.]

[Figure No.5 Salting out method]



Polymer+Drug
Aq solution
Stabilizer in Water
Addition of sufficient Water
diffusion of drug
Aq.phase
Formation of nanoparticles

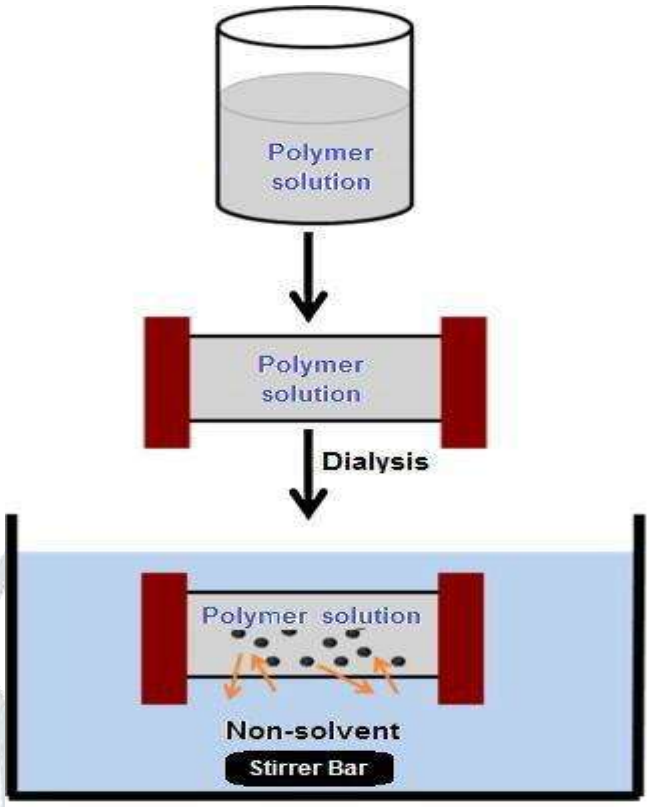
In this method first step is a mixture of polymer and drug solution to a Aq. Solution than Stabilizer in water this is stage of salting out agent . Than the drug is diffuse in in aq. Phase than the formation of nanoparticles .

D. Dialysis method

Dialysis method is effective methods of dialysis . In this method used in poly benzyl-1-glutamate, b-polyethylene oxide dissolved in solvent. This solution added to Dialysis and against a non solvent miscible by miscible. The solvent is inside the membranes followed by progressive aggregation of polymer loss of solubility and conformation of homogeneous suspension of nanoparticles.[9.12.]

Organic Solution
Polymer+ Drug
Organic solvent
Solution added in Dialysis tube
Than dialysis
Formation of nanoparticles

. **[Fig.No.6 Dialysis Method]**



E. Supercritical fluid technology

Supercritical fluid is define as a solvent at temperature above it's critical temperature at which fluid remain single phase regardless of pressure. The Supercritical is commonly used in carbon dioxide is commonly used in Supercritical fluid.

The two technique used in Supercritical fluid technology

1.Supercritical Ant solvent.[SAS]

2. Rapid Expansion Of Critical Solution [RESS]

1. Supercritical Anti solvent.

In this method used in liquid solvent (methanol) which completely micible in Supercritical fluid than extract of liquid solvent by Supercritical fluid leads to instantaneous precipitation of solute than formation of Nanoparticles [13]

2.Rapid expansion of Critical Solution [RESS]

In the high degree of super saturation occurs by dissolving in solute in Supercritical fluid to form solution followed by rapid expansion of solution across in orifice or capillary nozzle in ambient air by rapid pressure reduction in expansion which results in homogeneous nucleation than the formation of dispersed particles.[6]

F. Coacervation or Ionic Gelation Method.

The method involves a mixture of two aqueous phases, one is the polymer Chitosan, a di-block co-polymer ethylene oxide or propylene oxide (PEO-PPO) and second is a polyanion sodium tripolyphosphate. This is method, positively charged amino group of Chitosan interacts with negative charged tripolyphosphate to form coacervates with a size in the range of nanometre. Coacervates are the result of electrostatic interaction between two aqueous phases, whereas, ionic gelation involves the material undergoing transition from liquid to gel due to ionic interaction conditions at room temperature. [42.43]

G. Polymerization Method.

In this method, A monomers are polymerized to form nanoparticles in an aqueous solution in which drug may be dissolved. The nanoparticle is a suspension that is purified to remove various stabilizers and surfactants using by a ultracentrifugation and resuspending the particles in an isotonic surfactant-free medium. This technique has been reported for making polybutylcyanoacrylate or poly (alkyl cyanoacrylate) nanoparticles. [44.45.]

Method	Drug used in method	Reference
Solvent Evaporation	Dichloromethane, chloroform, ethyl acetate	[6]
Spontaneous Emulsification or Double Emulsification	Hydrophilic	[7]
Double Emulsification	O/W emulsion	[1]
Nanoprecipitation method	Ethyl cellulose, Eudragit, propylene glycol	[6.10]
Salting out method	Acetone	[8.10.11.]
Dialysis method	Polylactide, Polybenzyl-1-glutamate, Polyethylene oxide	[9.12.]
Supercritical fluid technology		

1.Supercritical Anti-solvent [SAS]	Methanol	[13]
2.Rapid Expansion of Critical Solution [RESS]	Fluid solution	[6]
Coacervation or Ionic Gelation Method	Ethylene oxide, propylene oxide, polyanion sodium tripoly phosphate	[42.43]
Polymerization Method	Polybutylcyanoacrylate and poly alkyl cyanoacrylate	[44.45]

Table 1[Drug used in Different Method]

Evaluation Parameter of Nanoparticles

1.Yield of Nanoparticles.

2. Particle Size

3.Composition

4.Surface Morphology

5.Polydispersity Index

6.Kinatic Study

7.Stabality of Nanoparticles

8.In vitro relse study

9. Surface Charge

1.yield of Nanoparticles

The yield of Nanoparticles is determined by comparing the whole weight of nanoparticles formed against the combined weight of copolymer and drug.[14]

$$\%yield = \frac{\text{Amount of nanoparticles}}{\text{Amount of drug and Polymer}}$$

2.Particle Size.

The particles size is one of the most basic and important measurements of nanoparticles. The particles size and distribution is most commonly measured in electron microscopy. The image of scanning electron microscope [SEM] and Transmission Electron microscope [TEM] are used for Measurements of particles size [15]

Scanning Electron Microscope [SEM].

It's a morphological examination with direct visualization . This technique based on Electron Microscope offered in morphological and sizing analysis [46]

Transmission Electron Microscope [TEM].

The Nanoparticles dispersion is deposited onto support grind or film. [47]

3.Composition.

The chemical or elemental composition determined the purity and performance of nanoparticles. The composition measurements is usually carried out X-ray photoelectron spectroscopy [16]. Some technique chemically digestion of particles followed by wet chemical analysis such as mass spectroscopy.

The particles in gaseous phase are collected either by filtration or electrostatic and spectrometry or wet chemical technique used for Analysis.[17]

4.Surface Morphology.

The nanoparticles posses in various shapes and structure that plays a key role in exploring properties. The surface is generally determined by electron microscopy imaging techniques like Scanning electron microscopy and transmission electron microscopy [18].

5. Polydispersity Index

Polydispersity Index is prepared of nanoparticles is carried out by using Malvern zestier.[19]

6. Kinetic Study

The kinetics study of nanoparticles were fitted in various kinetics equation like zero order [cumulative % relse vs time]. [20]

7. Stability of Nanoparticles

The stability study of nanoparticles is determined by storing optimization formulation at 4°c_+ 1°c and 30°c -+ 2°c in stability chamber for 90 days. The sample analysis after a time period like ate 0,1,2,&3 months for their drug content [21]

8. In vitro relse study

In vitro drug release study were performed in usp type2 dissolution apparatus at rotation speed of 50rpm the prepared in 900 ml of phosphate buffer solution in vessel and temperature is maintained at 37-+ 0.20°c required quantity 5ml of medium in specific time period and some volume of dissolution medium the sample is withdrawn in UV spectrophotometer [22]

9. Surface Charge

The nature and intensity of the surface charge of nanoparticles is very important as it determines their interaction with the biological environment as well as their electrostatic interaction with bioactive compounds. The colloidal stability is analysed through zeta potential of nanoparticles. The measurement of the zeta potential allows for predictions about the storage stability of colloidal dispersion. High zeta potential values, either positive or negative, should be achieved in order to ensure stability and avoid aggregation of the particles. [50].

Properties Of Nanoparticles

The properties of nanoparticles is based on two categories in physical and chemical

Carbon Based on Nanoparticles

Metal Based on Nanoparticles

Metal oxide based on nanoparticle

1.Carbon based on Nanoparticles

À. Fullerenes.

Safe and inert, semiconductor and superconductor, transmit light bases on intensity.

Fullerenes containing from 28 to 100 carbon atoms, each containing in C60. This is l composed of interconnected carbon pentagons and hexagons, resembling a soccer ball. Fullerenes are class of materials displaying unique physical properties .[49]

B. Carbon Nanofiber .

High thermal , high electrical frequency, shielding and mechanical properties. [23]

C. Carbon Nanotubes.

High electrical, thermal conductivity tensile strength flexible and elastic [24]

Carbon nanotubes are hexagonal network of carbon atoms, 1 nm is a diameter and 100 nm in length of nanotube as a layer of graphite rolled up into cylinder.CNTs are of two types, single walled carbon nanotubes (SWCNTs) and multi-walled carbon nanotubes (MWCNTs) .The small dimensions of carbon nanotubes, combined with their remarkable physical, mechanical and electrical properties make them unique materials. [48].

D. Graphene .

Extreme strength, thermal electrical conductivity, light absorption.[25]

Carbon black

High strength, electrical conductivity, surface area resistant to UV degradation [26]

2. Metal Based on Nanoparticles

A. Aluminium.

High reactivity, sensitive to moisture, heat and sunlight, large surface area.[27]

B.Iron

Reactive and unstable, sensitive to air oxygen and water [28]

C.Gold.

Interactive with visible light reactive.[29]

D. Cobalt.

Unstable , magnetic, toxic, absorb microwave, magnetic [30]

E.Lead.

High toxicity, reactive,heighely stable [31]

F Copper

Hi, very high thermal and electrical conductivity highly flammable solid [32]

G.Zinc.

Antibacterial, anticorrosive, antifungal, uv filtering. [33]

3.Metal oxide based on Nanoparticles

A. Titanium oxide.

High surface area, inhibit bacterial growth.[34]

B.Iron oxide.

Reactive and unstable [35]

C.Mangentide.

It's highly reactive. [36]

D. Silicon Dioxide

It's less toxic, [37]

E.Crium oxide.

It's low reduction potential.[38]

F.Aluminium oxide.

It's sensitive to moisture heat and sunlight.[39].

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