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Review on Nanosuspension Using Polymer

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ABSTRACT

Targeted and controlled drug delivery can be achieved through the innovative use of nano particles.Solubility is the most important factor in pharmacological efficacy, irrespective of the delivery method. A lot of recently created drugs are less bioavailable due to their water insoluble nature, which exacerbates desertification. Nanosuspensions have emerged as a promising technique for the efficient delivery of hydrophilic drugs due to their numerous applications and unique advantages. Bioavailability is increased when drug particles are decreased to submicron sizes because they dissolve much more quickly. It is possible to deliver nanosuspensions orally or non-orally. The study focuses on various preparation methods, their advantages and disadvantages, characterization traits, and applications.

Keywords: nanoparticles, nanosuspension, hydrophilic medications, submicron sizes

INTRODUCTION

Nanoparticles are ultra small colloidal structures composed of synthetic or semi-synthetic polymer polymer materials.Solid core spherical particles with a nanometric dimension are called nanospheres.They include either adsorbed onto the surface or embedded in the matrix.The medicine is effectively enclosed within the centre volume of nanocapsules, which are vesicular systems encased in an embryonic polymeric sheath.The medication is mostly contained in the solution system of nanocrystals.[1]

A modified natural carbohydrate polymer called chitosan is made by partially N-deacetylating chitin, a naturally occurring biopolymer found in the shells of crustaceans like crabs, prawns and lobsters. Chitosan is also present in several yeasts, fungi, and microbes. While chitin is insoluble in the majority of solvents, chitosan dissolves in the majority of organic acidic solutions, such as citric, tartaric, acetic, and formic acid, at pH values below 6.5. It cannot be dissolved in sulphuric and phosphoric acid. The molecular weight and degree of deacetylation of chitosan vary greatly. The primary determinants of particle size, formation, and aggregation are molecular weight and degree of deacetylation.[2,3]

Recently, the formulation of such drugs as nanoscale systems (which have a size below 1μm) has rapidly evolved as a new and novel drug delivery system. The major characteristic of these systems is the rapid dissolution rate, which enhance bioavailability after oral administration.[4]

Reviewing nanosuspensions as a new and promising technique for the formulation of poorly soluble medications is the goal of this paper.

Nanoparticles are not the same as nanosuspensions. Solid lipid nanoparticles are lipidic drug transporters, while nanoparticles are often polymeric colloidal drug carriers. By maintaining the medicine in a crystalline state with smaller particles, nanosuspension technology improves bioavailability by increasing the rate of dissolution. Both crystalline and amorphous forms of pharmaceutically recognised drugs are present in nanosuspensions. Brick dust molecules can be effectively formulated using nanaosuspensions for better absorption and dissolution.[5]

Definition

A pharmaceutical nanosuspension is defined as “pure poorly water-soluble drug without any matrix material suspended in dispersion, with reduced particle size, leading to an increased dissolution rate and therefore improved bioavailability”. The suspended particle has a diameter of less than 1 μm, or between 0.1 and 1000 nm.[6,7] Solid particles in nanosuspensions typically have a particle size range of less than one micron, with an average particle size of 200–600 nm.[8]

Advantages of nano suspension[9]

1. An increase in the drug's saturation solubility and dissolution velocity
2. Improved biological performance
3. Manufacturing simplicity and scalability
4. Versatility
5. An increase in oral absorption
6. Enhanced proportionality of dosage.
7. It can be used for medications that are not very soluble in water.
8. It can be administered in any way.
9. Less tissue irritation whether administered intramuscularly or subcutaneously.
10. The intravenous method of delivery allows for rapid breakdown and tissue targeting.
11. Oral administration of nanosuspension offers enhanced bioavailability, a decreased fed/fasted ratio, and a faster start.
12. A decrease in particle size might result in an increase in the absorption form absorption window.
13. greater bioavailability and more reliable dosage for inhalation and ocular administration.
14. To improve their bioavailability, medicines with a higher log P value can be made into nanosuspensions.
15. A rise in biological performance as a result of the medications' high rate of dissolution and saturation solubility.
16. Nanosuspensions are appropriate for a variety of administration routes and can be added to tablets, pellets, hydrogel, and suppositories.
17. Raising the particles' amorphous proportion, which could alter their crystalline structure and increase their solubility.
18. The potential for site-specific delivery through surface modification of nanosuspension.
19. The ability to produce on a wide scale, which is a requirement for launching a delivery system.
20. Its general applicability to most drugs & simplicity.

Disadvantages for Nanosuspension Drug delivery system[9]

1. It is heavy enough that handling and transportation require caution.
2. The wrong dosage.
3. It is impossible to obtain a consistent and precise dosage.
4. Compaction, sedimentation, and physical stability can all lead to issues.

Need of nano suspension Over 40% of medications have poor water solubility, which makes it difficult to formulate them in traditional dosage forms. For class II as well The issue is more complicated when it comes to medications that are poorly soluble in organic and aqueous fluids.For substances with a high log P value that are insoluble in water but soluble in oil, nanosuspension preparation is recommended. Numerous strategies to address issues with low bioavailability and low solubility Other methods include liposomes, emulsions, microemulsion, solid dispersion, ß-cyclodextrin inclusion complex, cosolvency, oily solution, salt

creation, and micronization. However, not all medicines can be treated with all of these methods.[10] .Drugs that are poorly soluble in lipid and aqueous solutions can have their solubility improved by using
Nanosuspensions media. As a result, the active component floods more quickly and the maximum plasma level is reached sooner (for example, when the nanosuspension is administered orally or intravenously (IV). One of its distinct advantages over alternative methods for improving solubility is this. It works well for compounds that have low permeability, poor solubility, or both, which presents a big problem for formulators. The following are the main problems with weakly water-soluble compounds:[11]

- Poor bioavailability.
- Inability to optimize lead compound selection based on efficacy and safety
- Fed/fasted variation in bioavailability
- Lack of dose-response proportionality
- Suboptimal dosing
- Use of harsh excipients, i.e., excessive use of co-solvents and other excipients
- Use of extreme basic or acidic conditions to enhance solubilization

Applications of nanosuspensions:[9]

Oral:

Although oral drug delivery is the most popular method of drug administration, some medications have limited bioavailability because of poor solubility and absorption, which ultimately lowers their effectiveness. In these situations, nanosuspension can help because it improves absorption and dissolution rate because of its increased surface area and improved adhesiveness.

Parentral:

Poorly soluble non-injectable medications can be changed into an intravenous administration-ready formulation using nanosuspensions. Current advancements in nanosuspension technology have demonstrated its usefulness as injectable formulations, despite the fact that parenteral manufacture is crucial.

Pulmonary:

Poorly soluble non-injectable medications can be changed into an intravenous drugs that are poorly soluble in pulmonary secretions may benefit from delivery using nanosuspensions.The current methods of pulmonary delivery, like aerosols or dry powder inhalers, have some drawbacks, like less residence time and restricted diffusion at the necessary spot, which can be addressed by nano-suspensions.

Dermal:

Poorly soluble non-injectable medications can be changed into an intravenous adThe drug diffuses into the skin more effectively in the nanocrystalline form due to its higher saturation solubility. Additionally, nanocrystals have a number of qualities that may be highly helpful for cutaneous application, including improved permeability, higher penetration into a membrane, and bioadhesiveness.

Methods of preparation of nano suspensions:[9]

Mainly there are two methods for preparation of Nanosuspensions. The term "bottom up technology" refers to the traditional precipitation techniques. The disintegration techniques known as "Top Down Technologies" are favoured over precipitation techniques.

1.Bottom up technology.

2.Top down technologies.

1.Bottom up technology:

The term "Bottom-up technology" means that one starts from the molecular level, and goes via molecular association to the formation of a solid particle. That means that we are discussing classical precipitation techniques by reducing the solvent quality, for example, by pouring the solvent into a nonsolvent or changing the temperature or a combination of both. Precipitation is a classical technique in pharmaceutical chemistry and technology.

2.Top down technologies:

The top down technologies include

a) Media milling

b) High pressure homogenization

Some other methods for preparation of Nano suspension

- Homogenization in water (DissoCubes).
- Media milling (Nanocrystal or NanoSystems)
- Homogenization in non-aqueous media (Nanopure).
- Combined precipitation and homogenization (Nanoedge).
- Nanojet technology.
- Emulsification-solvent technique.
- Hydrosol method
- Supercritical fluid method.
- Dry co-grinding
- Emulsion as template
- Microemulsion as template

Characterisation of nanosuspension

The properties of nanosuspensions are described for test, associated impurities, particle size, zeta potential, crystalline state, appearance, colour, odour, dissolution investigations, and in vivo studies.

1.Particle size and size distribution

several characteristics of nanosuspensions, including physical stability, dissolving velocity, saturation solubility, and Both the mean particle size as well as the distribution of particle sizes affect biological performance. Coulter current multi-sizer, laser diffraction, and photon correlation spectroscopy (PCS) can all be used to measure the mean particle size and particle width (poly-dispersity index). A low polydispersity index (PI) is necessary for the nanosuspensions to remain stable over time.[4]

2.Zeta potential

Zeta potential determines the stability of the nanosuspension. Both the stabilizer and the drug, govern the zeta potential of a nanosuspension.[4]

3.Stability

Nanosuspensions Stability depends on the particle size of the suspended particles. Decrease in the particle size to the nano range increases the surface energy of the particles, and the tendency of the particles to agglomerate increases.[12]

4.pH

The pH of the nano suspension can be measured by pH meter.

5.Osmolarity

Osmolarity of nanosuspension can be measured by using osmometer[7].

Formulation consideration:[13-20]

Organic solvent:

Organic solvents are used in the formulation of Nanosuspension if emulsions or micro emulsions are used as a template. The pharmaceutically acceptable less hazardous water miscible solvent, such as methanol,ethanol, chloroform, ispropanol

Stabilizers:

The primary purpose of a stabiliser is to provide a steric or ionic barrier to completely wet the drug particles and stop Ostwald's ripening and agglomeration of nanosuspensions, resulting in a physically stable formulation. The kind and quantity of stabiliser significantly affects the nanosuspension's in vivo behaviour and physical stability.

Co-surfactants:

The choice of co-surfactant is critical when using microemulsions to formulate Nanosuspensions. Since cosurfactants can greatly influence phase behaviour, the effect of co-surfactant on uptake of the internal phase for selected micro emulsion composition and on drug loading should be investigated.

Others additives:

Nanosuspensions may contain additives such as buffers, salts, polyols,

CONCLUSION:

Nanosuspensions seem to be a novel and yet economically feasible way to address issues like low bioavailability that arise when hydrophobic medications—such as those that are poorly soluble in organic and aqueous media—are delivered. To increase drug absorption and bioavailability, the solubility issues of poorly water soluble medications have been largely resolved. To increase drug absorption and bioavailability, the solubility issues of poorly water soluble medications have mostly been resolved. Traditional dosage forms, such as tablets, capsules, and pellets, can be combined with nanosuspension technology to create parenteral medicines.

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Conflict of Interest Statement:
The authors have no conflicts of interest to declare.