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Review Article

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NANOSUSPENSION: AN EMERGING METHOD OF DRUG DELIVERY

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ABSTRACT

Background: Nanosuspension is an innovative drug delivery method emerging as a new approach to overcome the various limitation of conventional drug delivery. Solubility and bioavailability are two major factor which limit the efficacy of pharmaceutical product. **Method:** this review describes the methods of pharmaceutical nanosuspension production including advantages and disadvantages, potential benefits, characterization tests, and pharmaceutical applications in drug delivery. **Result:** Various techniques are used in formation of nanosuspension like homogenization, milling, precipitation etc. Nanosuspension is found to have a great potential to solve the issue of delivery of active pharmaceutical gradient having poor bioavailability, solubility. It also help in enhancing the site specific delivery. **Conclusion:** Nanosuspensions can be delivered by oral, parenteral, pulmonary and ocular routes. Nanosuspension technology is able enough to bring enormous immediate benefits and will revolutionize the research and practice of medicine in the field of pharmacy.

KEYWORD: Nanosuspension, solubility, homogenization, emulsion.

INTRODUCTION

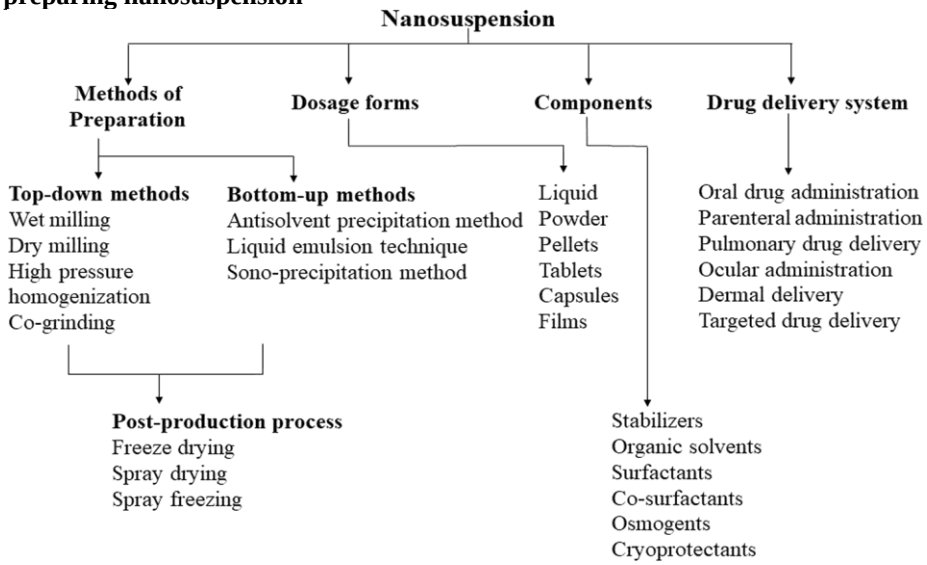
Nanosuspension is combination of two words i.e. Nano means very small, minute one billionth part 10^{-9} and suspension means heterogenous mixture in which solute particles are suspended in the solvent floating freely in the medium. Nanosuspension is biphasic in nature in which colloidal solid fine particles are dispersed in aqueous vehicle stabilized by surfactants.[1,2] The two main factor which play a critical role in formation of new pharmaceutical product is solubility and bioavailability.[3] To solve these problems researchers are involved in finding new methods of drug delivery to increase the solubility and bioavailability of drug. Nanosized particle formulation can be made of all drug particle belonging to class II & IV of Biopharmaceutical Classification System (BCS).

There are many approaches for increasing the solubility of drugs like microionization, precipitation techniques, surfactant dispersion, emulsion, microemulsion, liposomes.[4] But these approaches are only suitable for drugs which are soluble in aqueous and organic solvents whereas nanosuspension technique can be used for drugs which are insoluble in both water and organic solvents. With increasing solubility and bioavailability nanosuspension technology also alter the pharmacokinetic property of drug leading to increased effectiveness and safety profile.[5]

Characteristics of drug to be selected for nanosuspension

1. Water insoluble but which are soluble in oil
2. Insoluble in both water and oils
3. Drugs with reduced tendency of the crystal to dissolve

Techniques for preparing nanosuspension[6]



A. High-pressure homogenization[7] This method is based on cavitation process. The suspension containing a drug and surfactant is forced under pressure through a nanosized aperture valve of a high-pressure homogenizer.

Homogenization can be used both in aqueous and non-aqueous media. Homogenization in non-aqueous media can be done by nanojet, nanoedge and nanopore technique.

Nanojet Technique-Suspension is divided into two or more than two parts in a chamber. The molecules colloid at high pressure with each other. The high shear force produced during the process result in reduction of the particle size.

Nanoedge- It is combination of homogenization and precipitation. Smaller particle size with better stability can be made in shorter time period.

Nanopore- Also known as deep freeze homogenization. Water free media or water mixture like PEG 400, PEG 1000 is used for homogenization.

B. Milling techniques—It is known as top-down approach. In this technique mechanical energy is used to break down coarse particle into fine particles.[8]

C. Emulsification-solvent— In this emulsification of drug in nonsolvent liquid is done after preparing solution of drug. High speed stirrer is used for creating shear force to control crystal growth and particle aggregation.

D. Precipitation – Also known as Solvent-antisolvent method. It is used for poorly soluble drug. In this technique, drug is mixed with organic solvent and after it is mixed with miscible antisolvent in presence of surfactant.[9]

E. Supercritical fluid process—Used to prepare nanoparticles from drug solution. In this process supercritical fluid is used in which drug is poorly soluble and a solvent which is miscible with the supercritical fluid. It forms particle size range 5-2000 nm in diameter.

F. Lipid emulsion/ microemulsion template —In this method, organic solvent or mixture solvent loaded with the drug is dispersed in aqueous phase containing suitable surfactant to form an emulsion. The organic phase is evaporated under reduced pressure to make drug particles.

Formulation of nanosuspension[10]

Stabilizer—Lecithin, Polysorbates, Poloxamers
Organic Solvents—Water miscible Solvents—ethanol, isopropanol
Partially water miscible—ethyl acetate, ethyl formate, butyl lactate
Surfactants—Tween & Spans
Co-surfactants—bile salt dipotassium, Transcutol, Ethanol
Other Additives –
Buffers – acetate & Phosphate
Cryoprotectants—Sugar & sucrose

Advantages of nanosuspension[11]

1. Enhanced rate & extent of absorption
2. Enhanced dissolution rate
3. Physical stability of drug is increased
4. Can be delivered through various route such as oral, parenteral, ocular, pulmonary.
5. Nanosuspension can be formulated with compounds insoluble in water but soluble in oil.
6. Site specific drug delivery

Limitation of nanosuspension[12]

1. Elevation in sedimentation rate during storage can lead to instability.

2. Due to their bulkiness wear and tear can occur during transportation and storage.
3. Manufacturing complications
4. Nanotoxicity
5. Crystal growth (Ostwald ripening)
6. Stabilizer needed.

Marketed product approved by FDA.[13]

Drug	Application	Formulation
Methylphenidate HCl	ADHD	Nanocrystal
Aprepitant	Chemotherapy induced nausea	Nanocrystal
Megestrol Acetate	Anti -anorexic	nanocrystal
Sirolimus	immunosuppressant	Nanocrystal
Tizanidine HCL	Muscle relaxant	Nanocrystal

Nanocrystal is a patented technology used for evaluating the new chemical entities having poor aqueous stability. This technology is developed by the Elan Corporation, Ireland.

CONCLUSION

Nanosuspension contributes a significant role in administering different drug entities through a variety of routes involves oral, transdermal, ocular, parenteral, pulmonary, *etc* with ease. The nanosuspension technology can be a beneficial approach for the betterment of humans due to its simplicity, improved solubility and dissolution. However, this field is quite challenging with several complications, therefore this field requires utmost research work for developing nanosuspensions.

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