



CODEN [USA]: IAJ PBB

ISSN : 2349-7750

INDO AMERICAN JOURNAL OF  
**PHARMACEUTICAL SCIENCES**  
SJIF Impact Factor: 7.187

Available online at: <http://www.iajps.com>

Review Article

## NANOSUSPENSION: TO ENHANCE SOLUBILITY OF POORLY SOLUBLE BCS CLASS II DRUGS

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### Abstract:

*Nanosuspensions represent a promising formulation strategy to enhance the solubility and bioavailability of poorly soluble drugs, particularly those classified under Biopharmaceutical Classification System (BCS) Class II. This class encompasses drugs that exhibit high permeability but low solubility, posing significant challenges for effective therapeutic delivery. Nanosuspensions involve the reduction of drug particle size to the nanometer scale, leading to an increase in surface area and dissolution rate. This review explores the methodologies employed in the preparation of nanosuspensions, including wet milling, high-pressure homogenization, and precipitation techniques. Additionally, the physicochemical properties, stability considerations, and potential applications of nanosuspensions in drug delivery systems are discussed. The review highlights the advantages of this approach, such as improved solubility, enhanced drug stability, and the potential for targeted delivery. Furthermore, recent advancements and regulatory considerations in the development of nanosuspension formulations are examined, emphasizing their role in overcoming the solubility challenges faced by BCS Class II drugs.*

**Keywords :** Nanosuspension, Solubility enhancement, BCS Class II drugs, Drug delivery, High permeability, Poorly soluble drugs, Particle size reduction, Wet milling, High -pressure homogenization, Precipitation Techniques, Bioavailability, Physicochemical properties, Stability, Targeted delivery, Formulation development

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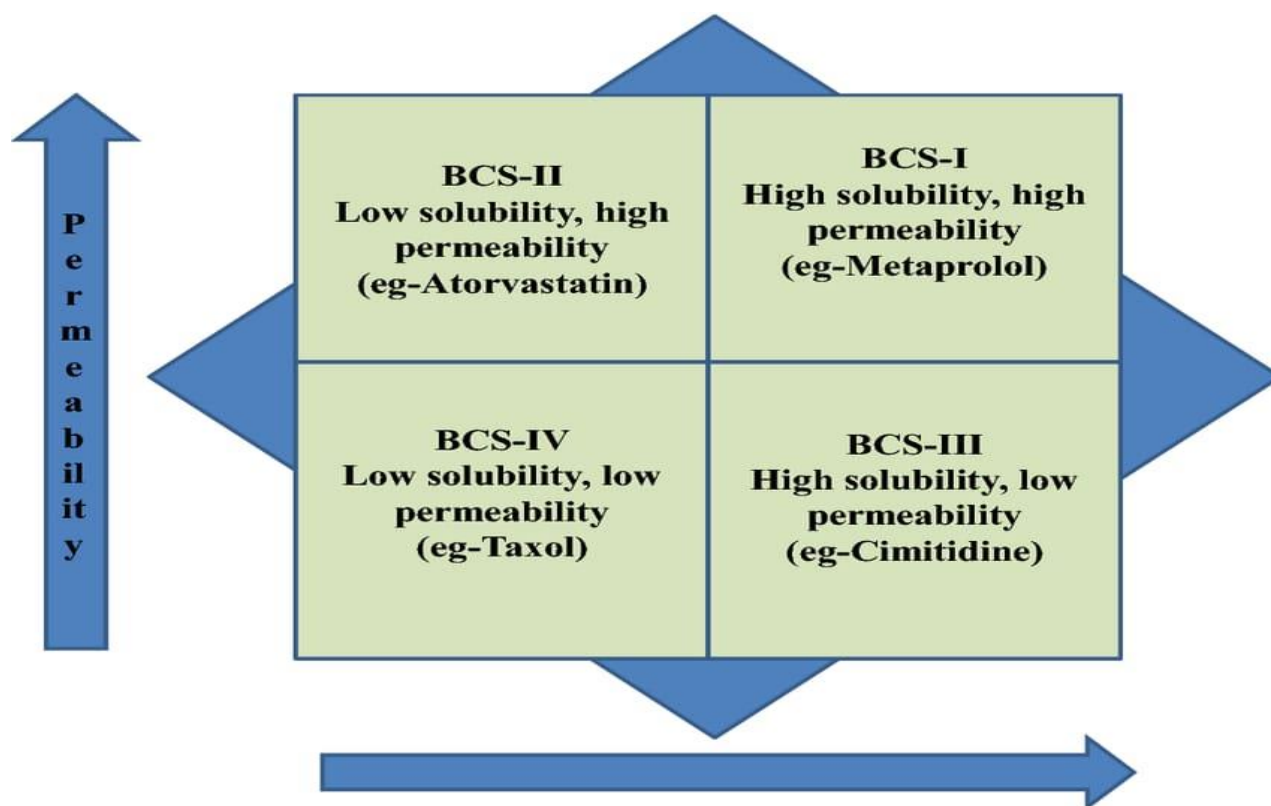
Please cite this article in press Sakshi R. Manekar et al., *Nanosuspension: To Enhance Solubility Of Poorly Soluble BCS Class II Drugs*, Indo Am. J. P. Sci, 2025; 12 (01).

**INTRODUCTION:**

Overview of the Biopharmaceutical Classification System (BCS)

The Biopharmaceutical Classification System (BCS) is a scientific framework that categorizes drugs based

on their solubility and permeability characteristics. It was developed to predict the absorption and bioavailability of oral drug formulations. The BCS classifies drugs into four categories:



1. **Class I:** High solubility, high permeability (e.g., Metoprolol).
2. **Class II:** Low solubility, high permeability (e.g., Fenofibrate).
3. **Class III:** High solubility, low permeability (e.g., Atenolol).
4. **Class IV:** Low solubility, low permeability (e.g., Furosemide).

- **Significance of Class II Drugs**

Class II drugs are particularly significant due to the following reasons:

**1. Poor Solubility:** Class II drugs exhibit low solubility in water, which can limit their absorption in the gastrointestinal tract. This often results in inconsistent and inadequate bioavailability.

**2. High Permeability:** Despite their solubility challenges, Class II drugs have good permeability across biological membranes. This characteristic can potentially allow for higher absorption rates when solubility is improved.

**3. Formulation Challenges:** The low solubility of Class II drugs poses formulation challenges, necessitating innovative approaches to enhance their

bioavailability. Strategies include using nanosuspensions, solid dispersions, and lipid-based formulations.

**4. Market Relevance:** Many marketed drugs fall into Class II, and their successful formulation is crucial for therapeutic efficacy. Enhancing their solubility can significantly impact treatment outcomes and patient adherence.

**5. Regulatory Implications:** Understanding the BCS classification assists in regulatory submissions and helps in establishing bioequivalence, especially for generic formulations.

**Nanosuspensions:**

Nanosuspensions are colloidal dispersions of nanoparticles of drug substances that are poorly soluble in water. These formulations typically consist of a drug in a solid state, stabilized by surfactants or polymers to prevent agglomeration. The particle size of nanosuspensions usually ranges from 1 to 1000 nanometers, with most particles being below 500 nanometers.

#### Potential Benefits of Nanosuspensions:

##### Enhanced Solubility and Dissolution Rate:

Nanosuspensions increase the surface area-to-volume ratio of the drug, which significantly enhances its solubility and dissolution rate, leading to improved bioavailability.

##### Improved Bioavailability:

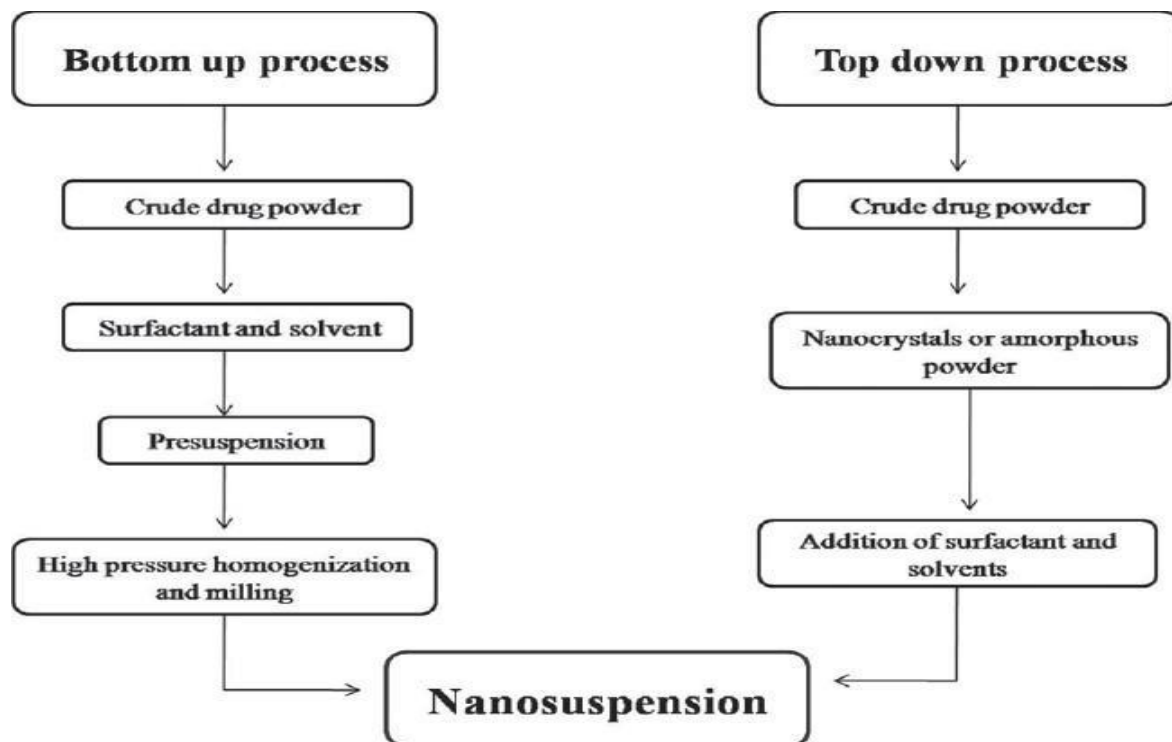
The enhanced solubility directly correlates with increased drug absorption in the gastrointestinal tract, making it particularly beneficial for poorly soluble BCS Class II and IV drugs.

##### Reduced Dose Size:

Higher bioavailability allows for smaller doses of the drug to achieve the desired therapeutic effect, potentially reducing side effects and enhancing patient compliance.

#### Preparation Techniques

There are several methods for preparing nanosuspensions:



**1.Top-Down Methods:** These include wet milling (e.g., media milling or high-pressure homogenization) where larger particles are broken down into nano-sized particles. Media milling, in particular, is widely used due to its efficiency in producing highly uniform particles.

**2.Bottom-Up Methods:** In this approach, the drug is dissolved in a solvent and then precipitated out into nano-sized particles. This method is beneficial for temperature-sensitive drugs, as it typically operates at lower temperatures.

**3.Combination Techniques:** Some newer techniques, such as the combination of bottom-up and top-down methods, are increasingly popular as they allow for more control over particle size and distribution.

#### Benefits of Nanosuspensions for BCS Class II Drugs

**1. Increased Surface Area:** The nano sized particles provide a larger surface area for dissolution, following the principles of the Noyes-Whitney equation, which states that the dissolution rate increases with surface area.

**2. Improved Bioavailability:** Enhanced solubility translates to improved bioavailability, as more of the drug becomes available for absorption in the gastrointestinal tract

### Applications of Nanosuspensions in Drug Delivery

**1.Oral Delivery:** Oral nanosuspensions improve absorption in the gastrointestinal tract for poorly soluble drugs, allowing for a more predictable and controlled release.

**2.Parenteral Delivery:** Injectable nanosuspensions offer an alternative to lipid or polymeric carriers.

**3.Pulmonary and Nasal Delivery:** Nanosuspensions allow for deep lung or nasal delivery of poorly soluble drugs, especially useful for localized treatments of respiratory diseases or for drugs that degrade in the gastrointestinal tract.

**4.Topical and Ocular Delivery:** Nanosuspensions enable enhanced drug penetration in ocular and skin applications.

### Stabilizers and Excipients in Nanosuspensions

**Surfactants:** Non-ionic surfactants like Tween 80 and Pluronic F68 are commonly used to reduce interfacial tension and stabilize particles. Ionic surfactants can also be used, but they are less common due to potential irritation or toxicity.

**Polymers:** Polymers like polyvinyl alcohol (PVA) and hydroxypropyl methylcellulose (HPMC) provide steric stabilization by creating a protective layer around the particles. This prevents particles from aggregating and stabilizes the suspension during storage.

### Future Directions

**Enhancing Stability:** Advances in stabilizer materials and novel formulation techniques (e.g., encapsulating nanosuspensions in solid lipid carriers) aim to improve long-term stability.

**Targeted and Sustained Release Formulations:** Combining nanosuspension technology with other delivery systems (e.g., liposomes, microparticles) could allow for targeted and sustained drug release, potentially improving efficacy in chronic diseases.

**Personalized Medicine Applications:** With the growth of precision medicine, nanosuspensions could enable individualized dosing regimens for patients based on metabolic profiles or disease states.

### Limitations and Challenges

While nanosuspensions offer significant advantages, they come with challenges, such as stability issues (e.g., Ostwald ripening, aggregation), the need for specialized equipment for production, and potential toxicity concerns with surfactants and stabilizers. Additionally, scaling up production while maintaining consistency in particle size and distribution can be technically challenging and costly.

### CONCLUSION:

Nanosuspensions represent a promising approach to overcome solubility issues for BCS Class II drugs, potentially enhancing their therapeutic efficacy. The continuous development in nanosuspension technology is making it an increasingly viable option in pharmaceutical formulations, though challenges such as long-term stability and manufacturing complexity need to be addressed to fully harness its benefits in drug delivery.

### REFERENCE:

1. Patel VR, Agrawal YK. Nanosuspension: An approach to enhance solubility of drugs. *J Adv Pharm Tech Res.* 2011; 2(2):81-87. Institute of Research and Development, Gujarat Forensic Sciences University, Gandhinagar, Gujarat, India.
2. Jakka V, Ramyamnagala G, Patnala DSP, Kuruba R. Nanosuspensions: a strategy to increase the solubility and bioavailability of poorly water-soluble drugs. *J Adv Pharm Tech Res.* 2023;16(5):33-40
3. Ma Y, Cong Z, Gao P, Wang Y. Nanosuspensions technology as a master key for nature products drug delivery and in vivo fate. *European Journal of Pharmaceutical Sciences.* 2023; 185(2023):106425
4. Bhowmik D, Harish G, Duraivel S, Pragathi Kumar B, Raghuvanshi V, Sampath Kumar K. Nanosuspension – A novel approach in drug delivery system. *The Pharma Innovation – Journal.* 2013;1(12):50-63
5. Aldeeb MM, Wilar G, Suhandi C, Elamin KM, Wathoni N. Nanosuspension-based drug delivery systems for topical applications. *International Journal of Nanomedicine.* 2024; 9:825-844. Correspondence: Nasrul Wathoni, Department of Pharmaceutics and Pharmaceutical Technology, Faculty of Pharmacy, Universitas Padjadjaran, Jatinangor, 45363, Indonesia.
6. Shahidulla SM, Miskan R, Sultana S. Nanosuspensions in pharmaceutical sciences: a comprehensive review. *International Journal of Health Sciences and Research.* 2023; 13(7):332-342.
7. Sinko PJ, editor. *Martin's physical pharmacy and pharmaceutical sciences*: Wolters Kluwer (India) Pvt Ltd, New Delhi; 2023:188-189
8. Jacob S, Nair AB, Shah J. Emerging role of nanosuspensions in drug delivery systems. *Biomaterials Research.* 2020; 24(3):1-16
9. Yadollahi R, Vasilev K, Simovic S. Nanosuspension technologies for delivery of poorly soluble drugs. *J Nanomaterials.* 2015;2015(1):216375.

- 10.Jadhav SP, Singh SK, Chawra HS. Review on nanosuspension as a novel method for solubility and bioavailability enhancement of poorly soluble drugs. *Adv Pharmacology and Pharmacy*. 2023;11(2):117-130.
- 11.Han J, Xiao B, Le PK, Mangwandi C. Enhancement of the solubility of BS class II drugs with MOF and MOF/GO composite materials: case studies of felodipine, ketoprofen, and ibuprofen. *Materials*.2023; 16:1-15.
- 12.Lakshmi P, Kumar GA. Nanosuspension technology: a review. *International Journal of Pharmacy and Pharmaceutical Sciences*. 2010; 2(4):35-40.
- 13.Attari Z, Kalvakuntla S, Reddy MS, Deshpande M, Rao CM, Koteswara KB. Formulation and characterisation of nanosuspensions of BCS class II and IV drugs by combinative method. *J Exp Nanoscience*. 2016;11(4):276-288.
- 14.Jassim ZE, Rajab NA. Review on preparation, characterization, and pharmaceutical application of nanosuspension as an approach of solubility and dissolution enhancement. *Journal of Pharmacy Research*. 2018; 12(5):771-774.
- 15.Geetha G, Poojitha U, Khan KAA. Various techniques for preparation of nanosuspension – a review. *International Journal of Pharma Research and Review*.2014; 3(9):30-37.
- 16.Chinthaginjala H, Ahad HA, Reddy PG, Kodi K, Manchikanti SP, Pasam D. Nanosuspension as promising and potential drug delivery: a review. *Int J Lifescience Pharma Res*. 2020; 1:59-66.
- 17.Sinko PJ, editor. *Martin's physical pharmacy and pharmaceutical sciences*:Wolters Kluwer (India) Pvt Ltd,New Delhi; 2023:384-385
18. Gigliobianco MR, Casadidio C, Censi R, Di Martino P. Nanocrystals of poorly soluble drugs: drug bioavailability and physicochemical stability.*Pharmaceutics*. 2018; 10:134.
- 19.Banavath H, Raju KS, Ansari MT, Ali MS, Pattnaik G. Nanosuspension: an attempt to enhance bioavailability of poorly soluble drugs. *Int J Pharm Sci Rev Res*. 2010;1(9):1-11.
- 20.Chauhan NN, Patel NV, Suthar SJ, Patel JK, Patel MP. Micronization of BCS Class-II drugs by various approaches for solubility enhancement – a review. *Research J. Pharm . and Tech*. 2012; 5(8):999-1005.
- 21.Singh VK, Chandra D, Singh P, Kumar S, Pratap Singh A. Nanosuspension: way to enhance the bioavailability of poorly soluble drug. *Int J Curr Trends Pharm Res*. 2013;1(4):277-287.
- 22.Phatak A, Jorwekar P, Chaudhari PD. Nanosuspensions: a promising nanocarrier drug delivery system. *Research Journal of Pharmaceutical Dosage Forms and Technology*. 2011; 3(5):176-182.
- 23.Kheradkar VA, Mulla JAS. Nanosuspension: a novel technology for drug delivery. *Asian J. Res. Pharm. Sci*. 2023; 13(2):106-110.
- 24.Malgundkar HK, Pomaje MD, Nemade LS. Breaking barriers with nanosuspension: a comprehensive review. *Biosci. Biotech. Res. Asia*. 2024; 21(1):57-68.
- 25.Pawar P, Yadav A, Gharge V. Different techniques for preparation of nanosuspension with reference to its characterisation and various applications – a review.*Asian J .Res. Pharm .Sci*. 2018; 8(4):210-216.
- 26.Sutradhar KB, Khatun S, Luna IP. Increasing possibilities of nanosuspension. *Journal of Nanotechnology*. 2013; (1):12.
- 27.Shinde ME, Sonawane MP, Maru AD. Solubility enhancement of simvastatin by preparation of nanosuspension. *Int. J. Pharm. Sci. Rev. Res*. 2021;71(1):97-101.
- 28.Hajare A. *Industrial Pharmacy-1*. Abhyudaya Pragati, 1312, Shivaji Nagar , Pune :Nirali Prakashan; 2021:1.10-1.12
- 29.Hajare A. *Pharmacy Pharmaceutics-1*. Abhyudaya Pragati, 1312, Shivaji Nagar , Pune :Nirali Prakashan; 2021:1.1-1.3
- 30.Brahmankar DM, Jaiswal SB. *Biopharmaceutics and pharmacokinetics*. GT Karnal Road, Delhi: M K Jain for Vallabh Prakashan; 2019: 338-339
- 31.Sinko PJ, editor. *Martin's physical pharmacy and pharmaceutical sciences*:Wolters Kluwer (India) Pvt Ltd,New Delhi; 2023:392-393
32. Khar RK, SP Vyas, Ahmad FJ , Jain GK. *Lachman/Liberman's Industrial Pharmacy*: CBS Publishers & Distributors Pvt Ltd ; 2013 : 907-946
- 33.Dhiman P, Bhatia M. Pharmaceutical applications of cyclodextrins and their derivatives. *J Incl Phenom Macrocyclic Chem*. 2020;98(3-4):171-86. Doi:10.1007/s10847-020-01029-3.