www.ijarp.com ISSN 2456-9992 Page: 01-06

International Journal Advanced Research Publications

Review Article

Volume: 02
Issue: 04

# NANOEMULSIONS IN PHARMACEUTICS: A REVIEW OF FORMULATION, CHARACTERIZATION AND APPLICATIONS

**R. David John Fabricius [(1*)], A. Jayakumar [(2)]**

[1]Department of pharmaceutics, Pallavan pharmacy college, Kanchipuram -631 503, Tamil Nadu, India.

[2]M.pharm, Associate professor, Department of Pharmaceutical chemistry, Pallavan pharmacy College, Kanchipuram -631 503, Tamil Nadu, India.

**Article Received: 25 February 2026, Article Revised: 15 March 2026, Published on: 05 April 2026**

***Corresponding Author: Mr. R. David John Fabricius**

Department of pharmaceutics, Pallavan pharmacy college, Kanchipuram -631 503, Tamil Nadu, India.

DOI: https://doi-doi.org/101555/ijarp.3967

**ABSTRACT:**

Nanoimals are refined colloidal drug delivery systems who have taken great interest in the field of pharmaceutics, which are not highly soluble in water due to their ability to improve drug stability, solubility, and their ability to improve -bioavailability. With the size of drops with 20 to 200 nm and a specific composition of oil, water, surfactants and co-surfacements, they offer special physical and chemical characteristics such as transparency, large surface area and long-term kinetic stability. High-energy techniques such as ultrasonication and high-pressure symmetry, as well as low-energy techniques such as phase inversion temperature and spontaneous emulsion, can be used to create nanoimals. The size of the drop, surface charge, morphology, and strengthening of formulation, methods of characterization such as dynamic light scattering, zeta potential measurements, electron microscopy, and stability are important. Their benefits include low dosage frequency, site-specific targeting, controlled release, and increased drug absorption, all of which increase patient compliance. In addition to its many uses in oral, parenteral, eye, nose, top, and transdermal drug delivery systems, Nanoimans are now being examined more and more for gene delivery, cancer treatment, and vaccination. The theranostic applications, hybrid systems, and vaccines based on Nano emulsions - which combine therapeutic and clinical ability - are the main subjects of recent developments. However, to reach their full capacity, obstacles should be resolved, including large-scale construction, long-term stability, stimulant poisoning and regulatory concerns. All things are believed to have a flexible and exciting

platform for all things, Nanoimans contemporary pharmaceutics, focusing on commercial translations, personal remedies and nano technology integration with future instructions.

**KEYWORDS:** Drug Transport, Formulation, Stability, Article Authors, Nanoimans, and Pharmaceutical Applications.

## INTRODUCTION:

New drug distribution technologies, especially based on nanotechnology, have been remarkably upgraded in the pharmaceutical business. Among them, Nanoimans have shown promise as a vehicle for the administration of medicinal substances. Surfactants have a size of drops between 20 and 200 nm, stable water and oil colloidal spreads, and nanoimans. They have special properties such as optical clarity, high kinetic stability, a giant surface area, and better drug solubility capacity due to the size of their small drops. Many novels of poor water solubility of medicinal compounds, which often result in low oral bioavailability, are one of the main obstacles in the development of the drug. By increasing the drug solubility, permeability, and absorption in the biological membrane, Nanoimals crossed this restriction. Additionally, due to their adaptability, they can be taken orally, parently, top, or nasally for a wide variety of medical purposes.

## NANOIMALSON COMPOSITION:

The stability, physical and chemical properties, and drug distribution efficacy of a nanolyst are all affected by its composition. Cum-surfactants and functional excipients are sometimes added to the three main components of an oil phase, aquatic phase, and surfactants that form a traditional nanolyson system.

- **Oil phase:** The oil phase directly affects the stability, release profiles, and drug loading capacity, in addition to serving as a reservoir for lipophilic drugs. Often used oils include oleic acid, soybean oil, castor oil, and medium-chain triglycerides (MCT). The oil option is based on how well it dissolves the drug and how well it works with biological systems.
- **Aquatic phase:** The aquatic phase is made of water or buffer solution and serves as a medium for hydrophilic drugs, promoting the spread of drops. The pH and ionic power of the aqueous phase can affect the stability of the drop.
- **Surfactants:** They stabilize the drops by reducing interfacial tension between water and oil. Because they are safe and biocompatible, non-ionic surfactants such as Poloxamers, Spanish (sorbiton esters) are often used.

❖ **Co-surfactants:** To pursue low interfacial tension and size of small drops, short-chain alcohols and glycols, such as ethanol, propylene glycol or polyethylene glycol are produced.

❖ **Excipients:** To expand the shelf life, prevent deterioration, and to preserve the quality of the formulation, additional stabilizers, antioxidants, and preservatives are often added.

Therefore, to create a stable, safe, and efficient nanoology formulation for drug applications, each component must be carefully chosen and optimized.

**WAYS OF PREPARATION OF NANOEMULSIONS:**

The preparation of nanoimals focuses on reducing the size of the scattered steps into the nanometer range, ensuring stability. These methods are roughly classified into high-energy and low-energy techniques, each of which has unique mechanisms, benefits and shortcomings.

**Low-energy technology**

These depend on the physical chemical properties of the system such as interfaceal tension and phase behavior.

**Step inverted temperature (pit):** Uses temperature-powered changes in surfactant solubility. In the pit, surfactant changes intimacy between oil and water stages, causing a spontaneous nanodropalat formation.

**Spontaneous emulsion:** Includes controlled mixture of oil, surfactant and co-surfactant with water, resulting in nanoskale drops without the requirement of external mechanical energy.

Comparative perspective High-energy methods are reproductive and industrially scalable, but expensive equipment and high energy inputs are required. Low energy methods are more economical and gentle on sensitive molecules, yet withdraws challenges with reproduced qualifications and scale-ups. The choice of the method depends on the drug properties, target drop size, needs of stability and the passage of administration.

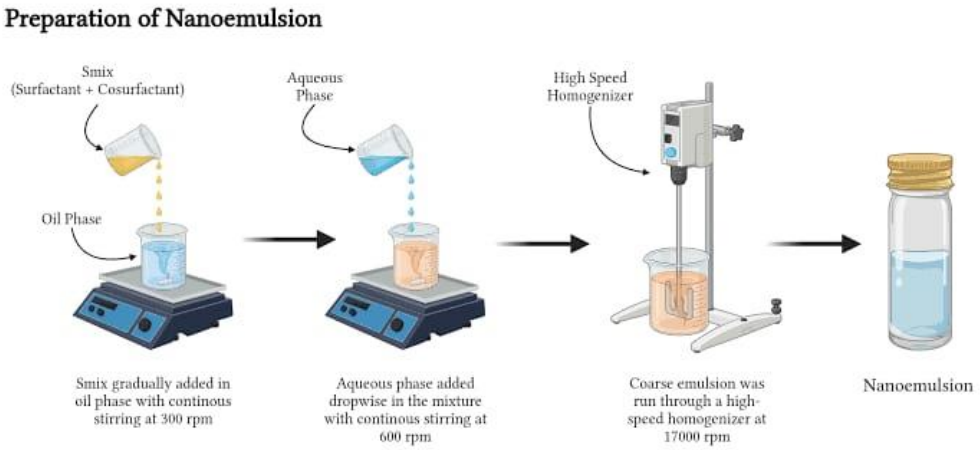


**FIG 01: PREPARATION OF NANOEMULSIONS.**

**SPECIALTY OF NANOEMULSION:**

The characterization ensures the quality, stability and suitability of the nanoimals for the use of the drug. Important assessment parameters include:

Vishaly and refractive index: drug release, transparency and administration properties. Thermodynamic stability: To evaluate the resistance of phase separation, tested through centrifugation, heating -cooling, and freeze -thick cycles. Drug loading and release: To assess loading capacity and release canetex, it is often determined using in vitro release studies through dialysis membrane.

**STABILITY IDEA:**

Nanoimals are kinetically stable, but are not thermodynamically stable. Their stability determines medical efficacy and shelf life.

1. Physical instability: Creaming, sedimentation, floculation, and covalent can compromise on symmetry and drug release.
2. Ostvald ripening: Small drops are dissolved and rearranged on large people, causing drop development and final separation.
3. Impressing factors: droplet size, surfactant concentration, oil type and storage conditions. Long chain triglycerides reduce the ustwald ripening.
4. Standing strategies: optimal surfact ratio to strengthen interfaceial films, using viscosity, antioxidants and co-surfacements.

**BENEFITS OF NANOEMULSIONS:**

Promoted solubility and bioavailability: improves disintegration of poor water soluble drugs. Better absorption and transit: The size of the small drop promotes interaction with the biological membrane.

Controlled and targeted delivery: Continuous release and site-specific action enables. Better patient compliance: Reducing low dosage frequency and versatile administration routes.

Multiple delivery routes: effective via oral, parentral, transdermal, oocular and nasal routes.

**DRUG APPLICATION:**

Nanoimals are used in various medical fields:

Oral distribution: Hydrophobic drugs (eg, cyclosporin, curcumin, paclitaxel) improves bioavailability.

Parentral delivery: Cancer therapy, anesthetics (eg, propofol), and nutritional emulsion are used.

Topical/Transdarmal: Increasing penetration for the status of dermatology and cosmetics. Oculaper delivery: Glucoma and improve penetration and retention for inflammatory therapy. Nasal distribution: facility of direct brain distribution in neurological disorders. Cancer and gene therapy: Distribute anticancer drugs, nucleic acids and sirna with low poisoning.

Vaccines: Work as an assistant (eg, MF59® in influenza vaccines).

Recent advances:

Nanoimals-based vaccines: Effective as immune assistants (eg, MF59®, Covid-19 research).

Therenostic system: Mixing therapeutic and clinical roles.

Hybrid nanoelation: Including polymer or solid particles for increased stability.

Stimulation-answer system: Tiger release by pH, temperature or enzymes.

Nano Technology Integration: Merged with liposomes, dendimers and nanokanas for multifunctional delivery.

**FUTURE PERSPECTIVES:**

Future research is expected to develop individual nanoology to suit patient-specific needs. Advance stimulation-post-existence-ex-yogas for targeted release.

## CONCLUSION:

Nanoimans are promising drug delivery systems that increase solubility, absorption and therapeutic efficacy. His role in advanced medical science continues to expand, with recent innovations such as hybrid design, vaccine adjuints, and therinomic applications. However, challenges in stability, scale-up and regulation should be removed. Nano technology, AI, and future integration with individual therapy are likely to establish nanoimans as a transformative platform in pharmacology.

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