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A Review on Nanoemulgel for Topical Drug Delivery System

Prafulla R Avhad[1], Rajashree S.Chavan[2], Jitendra V. Shinde[3], Utkarsha Khade[4], Harshada S. Shirsode[4] , Vinayak Patharwat[6]

[1,5,6]Master Of Pharmacy In Department Of Pharmaceutics, Seth Govind Raghunath Sable College Of Pharmacy Saswad (412301), Pune, Maharashtra
.[2]Department Of Chemistry, Seth Govind Raghunath Sable College Of Pharmacy Saswad (412301), Pune, Maharashtra
[3]HOD Department of Pharmaceutics, Seth Govind Raghunath Sable College Of Pharmacy Saswad (412301), Pune, Maharashtra
[4]Assistant Professor HOD , Department Of Pharmaceutics, Seth Govind Raghunath Sable College Of Pharmacy Saswad (412301), Pune, Maharashtra

ABSTRACT

Nanoemulgel, a well-known transdermal delivery tool, has demonstrated a surprisingly high efficacy for lipophilic medicines compared to other formulations. Newly discovered medicines have poor bioavailability and pharmacokinetic variability due to their lipophilic nature. Due to these two properties, nanoemulgels are suitable candidates for drug delivery.

Keywords: Nanoemulgel, gelling agent, homogenization, ultrasonication,

INTRODUCTION

One of the rapidly emerging novel applications that has been increasingly linked in many requests is nanotechnology, especially in the biopharmaceutical, dietary, and beauty care product industries.[1] Products containing nanotechnology seem to have a lot of potential due to their main features, which include small beads with a large interfacial range, improved dynamic ingredient delivery, and remarkable solubility.[2]

Emulgel[3]

Emulgels are emulsions of water in oil or oil in water that have been gelled through the addition of a gelling agent. Emulsified gel is a stable and better carrier for drugs that are hydrophobic or have low water solubility. Emulsions mixed with gels are known as emulgels.

Nanoemulgel[4]

Oil-in-water or water-in-oil nanoemulsions that are gelled by mixing them with the right gelling agent are known as nanoemulgels (NEGs). Because of their nano-sized small droplets, they have a high patient acceptance, display higher skin penetration, and combine the advantages of gels and nanoemulsions. They are being used to apply a range of drugs through the skin as a result. Since nanoemulgel has two characteristics—a gel base and a nanoemulsion—it is regarded as one of the best options for medicating skin.

The pharmaceutical industry has widely utilized Nanoemulgel's advantages. Numerous considerations and analyses of the formulations and development of nanoemulgel for the treatment of various local people as well as systemic afflictions from both nanoemulsion and gel have led to nanoemulgelrealising tall persistent worthiness. These investigations and analyses have been conducted for the endless conveyance frameworks such as transdermal, vaginal, visual, dental, and nose to the brain.

Components of nanoemulgel[5]

a) Aqueous phase

Generally, distilled water or ultra-purified water are utilised to create the nanoemulgel composition.

b) Oil phase

The selection of oil or other lipid components must ensure that the oily phase is real and shielded from impurities like peroxides, free radicals, and other fatty acids like sterols and polymers. The oils employed in the nanoemulsion are typically oils that are used to transport the medication. Fixing oils that are aperient and plentiful include cotton seed oil, corn oil, peanut oil, vegetable oil, essential oil, rose oil, clove oil, etc.

c) Surfactants and Co-surfactants:

Among the non-ionic surfactants that are frequently utilised are the esters of sorbitan and polyoxyethylene fatty acids. Co-surfactants are typically utilised to reduce surfactant concentration and to improve the product's thermodynamic stability. Co-surfactants include, among others, ethyl alcohol, PGs, glycerine, Transcutol HP, and PEGs.

d) Penetration enhancers

One of the finest methods to improve transportation efficiency through the skin and related layers has been to use penetration enhancers. One of the main components of the traditional drug delivery system, penetration enhancers are typically utilised in topical nanoemulgel.

e) Gelling agent

One of the key components of nanoemulgel that provides the formulation its ideal structure is the gelling agent. These are cross-linking agents logically. Among the gelling agents that are employed are Carbopol, HPMC, and Tragacanth.

f) Preservatives

Chemicals known as preservatives are used to protect a material from microbiological degradation and extend a product's shelf life. Preservatives including methyl paraben, propyl paraben, benzalkonium chloride, and phenoxyethanol are frequently utilised.

g) Antioxidants

Chemical compounds called antioxidants are used in compositions to prevent various components from oxidising. For example, ascorbylpalmitate, butylated hydroxyl toluene, etc.

ADVANTAGES[6]:

- The capability of avoiding first-pass metabolism.
- It has been demonstrated that this method of controlled, long-term drug distribution is effective.
- Soft on the skin.
- Fit for self-medication.
- The patient gets over it fast.

DISADVANTAGES[7]

- The surfactant that is employed in pharmaceutical applications should not be toxic.
- Itchy skin associated with contact dermatitis.
- During the formulation of emulgel, bubbles developed.
- The potential for allergic reactions

METHOD OF PREPARATION FOR NANOEMULGEL:

A particular kind of gel formulation known as nanoemulgel combines hydrophilic matrix with nanoscale oil or other hydrophobic material droplets. The general techniques for making Nanoemulgel are as follows:

High-pressure homogenization method[8]

With this technique, the oil phase is broken down into nanosized droplets that are easily dispersed in a hydrophilic gel matrix using a high-pressure homogenizer. High shear forces produced by the homogenization process aid in reducing droplet size and producing a stable Nanoemul gel.

Ultrasonication method

This technique uses ultrasonic vibrations to make nanoemul gel. After the hydrophilic matrix and oil phase are combined, high-frequency ultrasonic waves are applied to the mixture. The oil phase is broken down into nanosized droplets by the ultrasonic energy, and these droplets are evenly distributed throughout the gel matrix.

Solvent evaporation method[10]
This process dissolves the hydrophilic matrix and the oil phase by using a solvent that is water soluble. After that, the solvent is removed under low pressure, resulting in a Nanoemul gel containing oil droplets that are the size of nanoparticles scattered throughout the gel matrix

Microfluidization method[9]
This process produces Nanoemul gel by passing the hydrophilic matrix and the oil phase via a microfluidizer. High shear forces produced by the microfluidizer spread the oil phase into nanoscale droplets within the gel matrix.

Self-emulsifying gel method:
Using a self-emulsifying drug delivery system (SEDDS)[34] that can produce nanoemul gel in situ is part of this technique. When exposed to water, the oil, surfactants, and co-solvents in the SEDDS combination can emulsify on their own. A Nanoemul gel is created when the SEDDS is combined with a hydrophilic gel matrix.

High-energy emulsification method:
In order to produce tiny droplets of the dispersed phase (oil) in the continuous phase (water), this technique uses a high-energy input. Numerous techniques, including sonication, high-pressure homogenization, and microfluidization, can be used to accomplish this. A gelling agent, such as a polymer or surfactant, can then be added to the resultant emulsion to turn it into a gel.

Phase inversion temperature (PIT)
These approach is based on the employment of a thermosensitive surfactant, which, at a given temperature, phases out of its water-soluble form and becomes insoluble. The dispersed phase can be trapped by the surfactant by changing the system's temperature, which causes the surfactant to form a gel-like structure.

Sol-gel transition method:
This technique uses a sol-gel transition system, in which a network of particles or polymers agglomerates in a solvent to produce a gel. This can be accomplished by mixing in a thermosensitive polymer or crosslinking agent to cause the emulsion to form a gel-like structure at a specific temperature or under specific circumstances.

Characterization of Nanoemulgel

- Viscocity.
- pH.
- Spreadability.
- Skin irritation test.
- Drug Content.
- In vitro Permeation Study.
- Study of drug release kinetics.
- Comparison of nanoemulgel with marketed products.
- Stability Study.

Spreadibility[12,13]
The spreadability of the nanoemulgel can be ascertained by measuring the spreading diameter between two glass slides. Calculate the gel's spreadability in centimetres by weighing approximately 0.5g of sample and placing it in the centre of the glass plate (forming a circle). Next, place another glass plate on top of the first one, push between the two slides, and wait five minutes.

Study of Drug Release Kinetics[14]
The combined release data were fitted to models representing Zero order, First Order, and Higuchi Models in order to investigate the drug release kinetics and process.

Stability Study
Samples of drug nanoemulsion formulation were sealed in ampoules and kept in stability chambers for two months at temperatures ranging from 250 C to an accelerated 40±20 C34. Duplicate samples were removed at 0, 1, and a few months to evaluate their chemical and physical stability. The physical stability was evaluated visually for physical modifications (drug precipitation, phase separation, etc.), and the mean globule size and zeta potential upon dilution with water were measured using a globule size analyzer. The chemical stability of the molecule was determined by measuring its UV visible spectroscopic process at 257 n

CONCLUSION

Hydrophobic medications can also be added with Nanoemulgels, a relatively new topical drug delivery technology that is a great way to combine hydrophilic and hydrophobic pharmaceuticals. In order to increase patient compliance, topical medication delivery will be utilised extensively in the upcoming years. Emulgels, with their non-greasy, gel-like qualities and comparatively high drug release rates, may become widely used as novel topical drug delivery formulations in the future

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