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Microemulgel : A novel Topical formulation for Drug Delivery

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Abstract

In the pharmaceutical sector, microemulgel is a novel and promising drug delivery technology. The oil, surfactant, and clear water phase form a stable dispersion that can be either kinetically or thermodynamically stable. Due to its advantages over current oral and topical drug delivery methods, such as its capacity to prevent poor drug bioavailability and phramacokinetic variability, microemulgel has become a popular new transdermal drug delivery approach.

Adding micro-emulsion with gel creates a novel approach that enhances stability and enables rapid, controlled drug release. Enhancing medication absorption and lipophilic drug therapeutic profile is the goal of the formulation-related technology known as the Microemulgel drug delivery system. The great patient tolerance of the formulation has led to a notable increase in microemulgel use in recent years. Due to the preparation's improved patient acceptance—which includes its non-greasy nature, ease of application, simple spreadability, and favorable safety and therapeutic profile—microemulgel's use has expanded recently. Notwithstanding these obstacles, microemulgel holds great promise for the future as the main topical delivery system for lipophilic medications.

This review emphasizes on the various kinds of microemulsions, their benefits over alternative dosage forms, and the ways in which they are made, described, and used in various sectors.

Key words : Microemulsion, Microemulgel, Gelling agent,Topical drug delivery, Lipophilic drug, Phase diagram.

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It is believed that the human skin is a useful and accessible part of the body for topical treatments. An adult's skin surface area is about 1.8 m^2, including 200-300 sweat ducts and 40-70 hair follicles. The pH of the skin ranges from 4 to 5.6 based on the exudate produced by the sweat glands.sweat ducts, the intact stratum corneum, and sebaceous glands are the three main entrance sites for molecules into the skin. Dead cells makeup the stratum corneum, the uppermost layer of the epidermis. As a strong water barrier, it shields the blood vesicles scattered under the skin's surface as well as the deep internal components.

The lipid matrix of the stratum corneum is a stratified structure made up of various fatty acids, cholesterol, ceramides, and cholesteryl ester.the drug must overcome obstacles like skin separation to deliver the right drug concentration at the desired area and enter the systemic circulation. A microemulgel will be the most effective solution for this purpose[1].

Throughout the history of conventional medicine, the human skin has been widely employed as the primary organ to distribute different medications and achieve the intended therapeutic effect.

The purpose of this action was to achieve the desired therapeutic effect. The Transdermal Drug Delivery System (TDDS), which has been a popular substitute for the oral route of drug administration in current medical practice for many years, has similarly made a significant contribution to health care. Patient drug administration can also be accomplished via the Transdermal Drug Delivery System (TDDS)[2].

Topical drug delivery methods provide various benefits, such as the ability to deliver medication more effectively and selectively to a particular area while avoiding the metabolic breakdown linked to systemic administration[3].

The drug needs to get through these barriers in order to reach systemic circulation and the desired concentration at the site of action. For this kind of need, a microemulsion gel with globule-shaped colloidal carriers would be the perfect formulation[4].

Drug delivery through a Topical route :

The characteristics of the Ideal formulations include patient compliance, self-administration, non-invasiveness, fewer side effects, and better pharmacological action. Topical route administration offers benefits such as avoiding hepatic first-pass effects, decreased side effectsdue to local action, enhanced percutaneous absorption and increased bioavailability with sustained deposition. It also reduces drug loss due to metabolism or decomposition and allowsdrug targeting at the desired site. Minimizing drug breakdown and constant delivery for prolonged period results in prominent movement of the drug across the stratum corneum barrier, improving bioavailability[5].

Drug may penetrate into the skin structure through-

I. thick stratum corneum, (SC)
II. Sebaceous follicle.
III. sweat ducts of skin,

The stratum corneum covers over 99% of the skin, making it possible for medications to be absorbed. The drug's rate

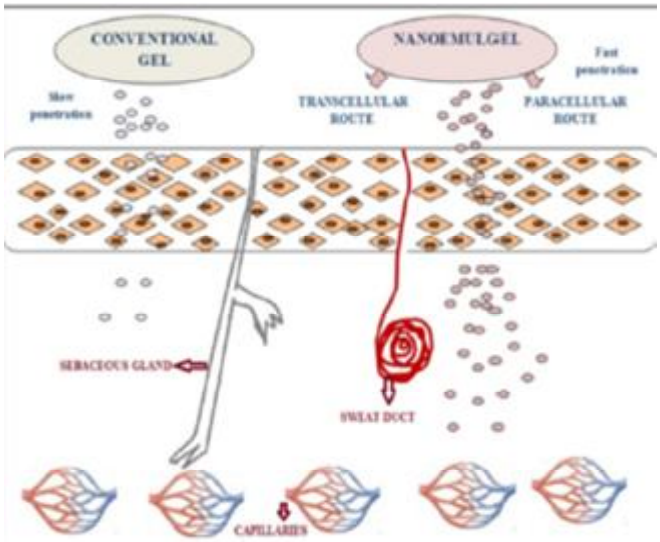

Figure-1. Graphical representation of microemulgel path of action showing penetration of microemulgel through both Paracellular and Transcellular route.[1]

Table-1. Comparison between conventional emulgel and Micro-emulgel[5].

Parameter	Conventional Emulgel	Micro-emulgel
Thermodynamic stability	Not stable due to the natural tendency of coalescence that causes creaming or sedimentation	Stable-because of their smaller particle size, Brownian motion provides enough stability against gravity, avoiding sedimentation or creaming
Particle size	Greater than>500nm	Less than 500nm
Bioavailability	Comparatively less bioavailable than Nano-emulgel	Enhanced bioavailability, attributed to small size and large surface area
Permeation	Comparatively lower permeation	High permeation owing to its lower particle size
Preparation	Require high energy techniques	It can be prepared either by using high or low energy techniques
Systemic absorption	Very minimal	Higher compared to conventional emulgel due to the small particle size and large surface area
Ability to cross BBB	Cannot cross BBB	Can cross BBB because of its small particle size

of percutaneous absorption is limited by passing through this stage. The development of a concentration gradient is one of the key processes in percutaneous absorption, which supplies the force required for drug adsorption through the skin[6].

Nanotechnology is one of the rapidly growing technical applications, that has been utilized more and more for a variety of purposes, particularly in the food, pharmaceuticals, and cosmetics sectors. Products including nano-technology have a promising market because of their superior qualities, which include tiny droplet size with high interfacial area, improved active ingredient delivery, and great solubilization capability.[5]

Microemulgel as Topical Drug Delivery System :

The combination of the hydrogel and microemulsion systems is known as microemulgel. Both technologies have some drawbacks, such as the low spreadability and retention of the microemulsion and the inability of hydrogels to include lipophilic molecules.[6] With droplet sizes ranging from 5 to 500 nm, microemulgel contains a variety of polymeric components, surfactants, and fatty compounds of natural, synthetic, and semisynthetic origin. It is possible to get around both methods' limitations with microemulgel. In order to create microemulgel—which permits the integration of a lipophilic drug into a hydrogel while also increasing the viscosity of the microemulsion—the lipophilic drug is dissolved in the oil phase of the microemulsion, which is then added to the hydrogel basis.[7]

Microemulgel is used in transdermal medication delivery as a drug reservoir. The medication initially enters the outer phase, then moves into the skin's surface from the inner phase. Oily droplets were liberated from the gel matrix of the microemulgel when it was applied to the skin. These droplets went through the stratum corneum to enter the skin deeply and deliver the drug moiety directly. [8] Both the crosslink density and the makeup of a network of polymer chains influence the drug release mechanism[9].

Microemulsion :

Microemulsion is a promising method for drug delivery, optimizing effectiveness and reducing toxicity. It consists of combining nano ranges of two immiscible liquids (water and oil) to form a homogeneous solution, with appropriate surfactants or cosurfactants. The stable, thermodynamic system ranges from 10-100 nm. Microemulsion enhances drug delivery by targeting poorly soluble drugs, increasing absorption through the skin, improving drug processing time, and reducing side effects[10]. The effects of microemulsion with nano-scale globules do not affect the emulsion's physical properties. Research shows that lacidipine bioavailability via transdermal route is 3.5 times higher than oral courses, due to avoidance of first-pass metabolism. Microemulsion also improves drug permeation across the skin, as the small size of particles allows more medication to be introduced into the mixture, enhancing thermodynamics towards the skin. The drug-affinity for partitioning also enhances skin permeation.[8]

Microemulgel :

Microemulgel is a gel base formation

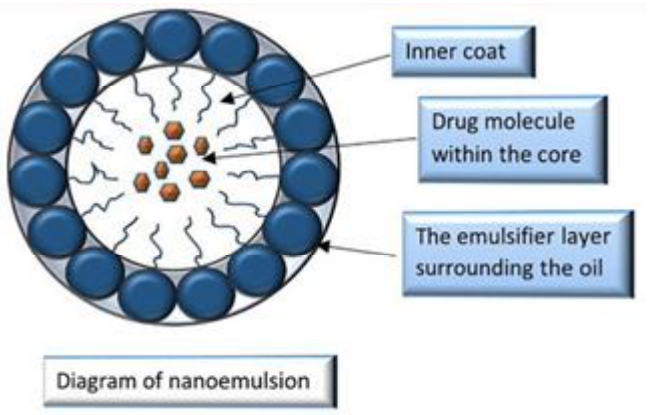

Figure-2. Structure of Microemulsion[9]

that contains microemulsion. It is created by incorporating a microemulsion system into a gel matrix, which improves skin penetration[11]. The drug reservoirs in this mixture of microemulgel affect the drug's release from the inner phase to the outer phase and beyond. Oil droplets are released from microemulgel when skin is still intact. These droplets enter the skin's dermal capillaries and transport the medication to the desired location. The drug is more likely to penetrate the skin when applied in microemulsion-gel form because of its strong adhesion properties and high drug solubilization in the oil phase, which results in a greater concentration gradient. When compared to creams and ointments, the greater spared ability and lower stickiness also result with improved patient compliance.[12]

Important content micro-emulgel :

A gel based microemulsion preparation for topical application comprises of specialized components apart from lipids and surfactants such as gelling agents, permeation enhancers, preservatives and antioxidants.

Aqueous phase :

In this impendence of gelling agent, this element is responsible for transforming the emulsion into an emulgel.For the composition of microemulgel generally ultra-purified water or the distilled water is used[1].

Oily 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. One of the primary factors taken into account when choosing lipids for the creation of microemulgels is the presence of most hydrocarbon chains; this decision was made with the fundamental principles of emulsification and consistency in mind. Mineral oil as a drug vehicle, cottonseed oil, maize oil, arachis oil, olive oil, coconut oil, eucalyptus oil, rose oil, clove oil, etc. are among the oils that are frequently employed in microemulsion.

Surfactants and Co-surfactants :

Due to the surfactant's amphiphilic nature,two immiscible phases can disperse, lowering interfacial tension and producing a stable enough filmto form around the droplets with the optimum curvature[13] Surfactants are molecules that can improve the stratum corneum (SC) diffusion coefficient by reversibly attaching to keratin filaments, destroying corneocytes, and improving penetration through the skin[14] Depending on the concentration of the surfactant combination, different medications have varying effects on skin penetration[15] when the concentration of surfactant increased, the permeation of hydrophilic drugs was significantly enhanced[16].

Surfactants are employed during the microemulgel production process to give the final formulation stability and emulsification. Non-ionic surfactants are employed in the creation of microemulgel due to their low level of toxicity. Non-ionic surfactants that are often employed include polyoxyethylene fatty acid esters and sorbitan fatty acid ester[3].

Co-surfactants are typically employed to reduce the concentration of surfactant and improve the final product's thermodynamic stability. Transcutol HP, PEGs, glycerine, PGs, and ethyl alcohol are a few examples of co-surfactants[1].

An emulsion cannot be stabilized only by a co-surfactant. Rather, by enhancing surfactant action in a synergistic way, it helps generate microemulsions (MEs) and microemulsions (NEs). Interfacial tension will be further reduced in particular by a co-surfactant. Moreover, it enables increased oil penetration between the surfactant tails, supporting the ideal interfacial film curvature[17].

Penetration enhancers :

One of the greatest approaches 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 method, penetration enhancers are typically utilized in topical microemulgel. These penetration enhancers typically function by interacting with the constituents of skin, resulting in a transient and cumulative elevation of skin permeability.

Gelling agent :

One of the key components of microemulgel 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.

Preservatives :

Preservatives are chemicals that are added to a product to prolong its shelf life by protecting the item from microbiological interference. Phenoxyethanol, benzalkonium chloride, methyl paraben, propyl paraben, and other preservatives are often employed.

Antioxidants :

Antioxidants are chemical substances that are used in compositions to prevent

oxidation of the different elements. Ex. Butylated hydroxyl toluene, Ascorbyl palmitate etc[1].

Pseudoternary Phase Diagram :

Surfactant and cosurfactant (Nmix) were mixed in different ratios (2:1, 3:1 and 5:1). Each ratio chosen in increasing amount of surfactant respect to co surfactant for a study on the phase diagrams. Here aqueous phase (Distilled water) used as dilution media. Oil and Nmix was mixed at different ratios from 9:1 to 1:9 in different vials for each Nmix. Main objective for this is to cover for the study to decide boundaries of phases formed in the diagrams. It was developed using titration method with help of water as aqueous media. Slow titration of oil and Nmix is performed and visual observations are made for transparency of Microemulsion. one axis represents the aqueous phase of the microemulsion, another represents the oil phase, and a third represents the Nmix (surfactant and co-surfactant) phase[6].

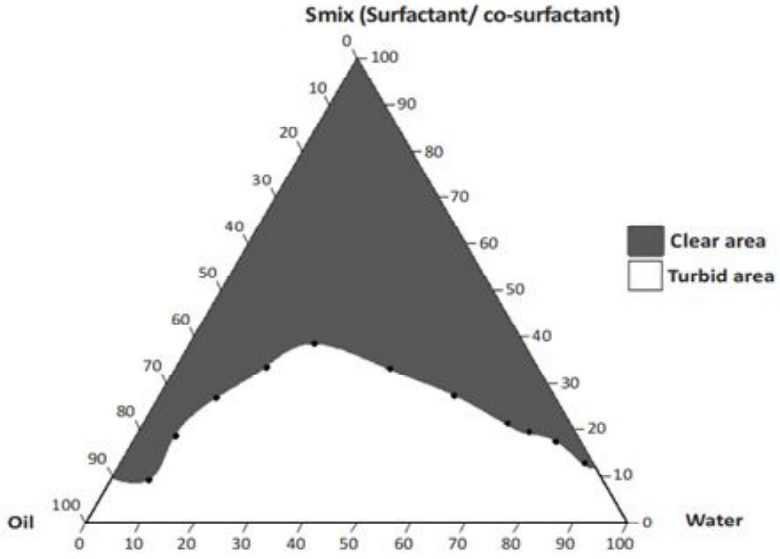

Figure-3 Schematic representation of pseudoternary phase diagram construction by aqueous titration method, the shaded area represents the clear transparent area of microemulsion and the unshaded area represent the turbidity[3]

Advantages of Microemulgels :

The microemulgel has a various of advantages over other topical formulations as well as conventional preparation, which are as follows-

- Avoid first pass metabolism.
- Easily accepted by the patient
- Appropriate for self-administration of medicines.
- Provide local delivery of drugs.
- Simple medication discontinuation.[2]

- Easily adapted to the environment of the skin.
- Proven efficacy for a controlled and sustained medication delivery system.
- Microemulgels don't cause irritation or toxicity.
- Improved medication loading as compared to other formulations.
- Enhance medication deposition and skin permeability[6]
- Offer a formulation with a higher spreadability than creams[12].

Limitations :

- It is a an Expensive process because a homogenizer is required to maintain nanoscale particle size.
- In order to maintain a nanoscale particle, the method is expensive due to the requirement for a homogenizer[19].

Enhanced drug permeability through skin:

The permeability of the drug through the skin has been significantly improved by microemulgel compared to other formulations because, in microemulgel preparation, the drug can permeate the skin layer through both paracellular and transcellular routes, whereas in microemulsion, only transcellular permeation route is observed. Figure illustrates a comparison of cumulative medication permeability through the skin from various formulations.[9]

Preparation methods of microemulsion:

The oil phase or the aqueous phase both dissolve the selected surfactant. The medicine is then introduced and dissolved in the aqueous or oil phase, depending on its solubility, then heated after that. After that, the mixture is continuously stirred while one phase is progressively added till it reaches room temperature.[9]

Step 1: Preparation of microemulsion :

A spontaneously formed microemulsion can be produced by adding high energy to the heterogeneous mixture or by mixing the

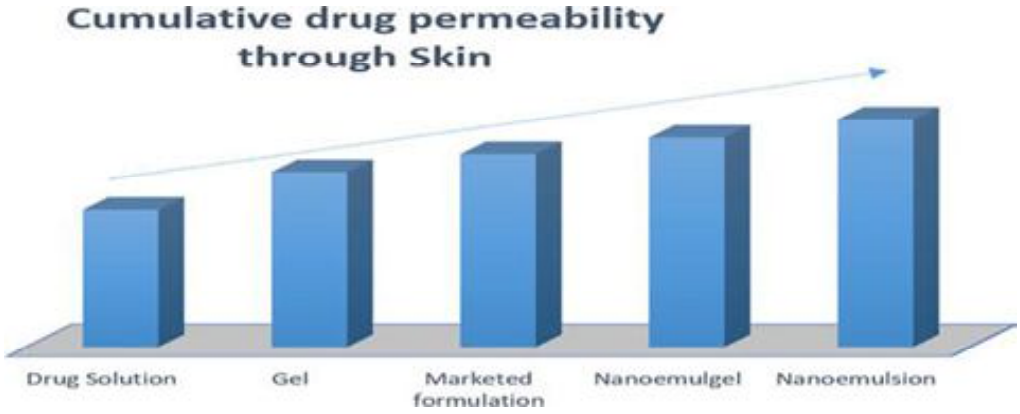

Figure 4- Cumulative drug permeability through skin[9]

compositions and reducing the interfacial tension between the oil/water interfaces. In order to create a thermodynamically stable microemulsion, both high-energy and low-energy emulsification techniques may be applied.

High-energy method :

Since the average size of a micro-emulsion droplet is between 5 and 500 nm, a significant amount of mechanical energy is needed to achieve this size. Numerous methods, such as high-pressure homogenizers, ultrasonic generators, microfluidizers, and high-speed homogenizers, can be used to achieve high-energy input for manufacturing. The main advantage of utilizing a high-energy mediated microemulsion formulation is the utilization of low emulsifier concentrations. The first stage in using high-energy methods is the mechanical churning that creates an emulsion with droplet sizes in the micron range. The second phase involves using high-energy equipment to split large droplets into tiny droplets, which transforms the emulsion into a microemulsion[20].

Ultrasonication :

The rough emulsion is transformed with a sonicator probe into desired nano-sized emulsion droplets. It is the sonicator probe that produces high-intensity sound waves with frequencies even higher than 20 kHz. This is capable of breaking up the rough emulsion into droplets that are nanosized (5-500nm). Size reduction up to acceptable levels is possible with a variety of probe kinds and diameters. Droplet scale is dependent on time, probe type, and strength of sonication input.

High-pressure homogenization technique :

In this technique, The globule size can be lowered to the nanoscale range using a piston homogenizer or high-pressure homogenizer (microfluidizer). In the microfluidizer technique, impact, attrition, turbulence, and hydraulic shear are delivered in addition to an extremely high pressure of around 500–20,000 psi during the emulsification process. The macro emulsion is changed into a coarse emulsion by the combined action of many forces, including cavitation, shear, and hydraulic pressures. The product is then put through the same procedure to produce droplets with the appropriate size and Polydispersity Index (PDI). A crucial component of the ideal emulsification is the number of homogenization cycles. Minimal levels of surfactant are utilized in this procedure, therefore there is very little risk of contamination.The homogenizers in piston-type homogenization processes function according to the colloid mill principle. The coarse emulsion is sprayed to a gap smaller than 10μm in dimension during this process of creating nanosized droplets. Here in the piston, a stationary stator and a continuously revolving rotor operate on the coarse emulsion until, after several high-shear rotation cycles, the coarse emulsion transforms into the appropriate size droplets.

Solvent Evaporation Technique :

This approach involves dissolving the medication in an appropriate phase to create an emulsion, which is then obtained by evaporating the drug. particle aggregation and crystal development during the precipitation process can be managed with the use of a high-speed stirrer.

The transdermal microemulsion exhibits a number of characteristics that impact the topical contact duration of the microemulsion, including excellent drug solubility, thermodynamic stability, improved penetration ability, and low viscosity. Because of this, different gel matrices, such as carbomer 934, HMC, acacia, etc., are included into the microemulsion, increasing its viscosity. Because of its dual control release and more viscous system, the microemulgel system—which is created by incorporating gel matrix into microemulsion—has a greater transdermal applicability than microemulsion. there are two ways to make the microemulgel: either put the gelling agent directly into the microemulsion or add it to the water phase first, forming a gel before adding it to the microemulsion. Both the O/W and W/O types of emulsion are used to make microemulgel.

Phase Inversion Method :

Phase inversion technique is presented by Shinoda et al. Phase inversion in this system is achieved by varying component composition at constant temperature, which modifies the system's chemical energy and promotes the creation of a homogeneous emulsion[21].

Sonication Method :

Particle sizes in the dispersed phase are decreased throughout the sonication process by use of a sonicator. However, this procedure is limited to small-scale manufacturing[21].

Low-energy method :

Low-energy emulsification techniques use less energy than high-energy techniques to produce microemulsion. The system's natural chemical energy is used to create microemulsion, and just gentle stirring is needed. Some low-energy methods are spontaneous emulsification and phase inversion techniques[20].

Spontaneous emulsification :

Spontaneous emulsification is among the most practical techniques for producing microemulsion. It consists of two liquid components: an organic component and an aqueous component. Water miscible solvents, surfactants, and co-surfactants are moved from the organic phase into the aqueous phase. The procedure begins with the introduction of an organic phase—such as oil and surfactant—into an aqueous phase, which is composed of co-surfactant and water. Rapid migration of water-miscible components into the aqueous phase raises the oil-water interfacial area and results in massive turbulence at the phase contact. Consequently, little oil droplets appear on their own[22].

Step 2: preparation of microemulgel :

The polymer is dissolved in purified water and continuously stirred with a mechanical stirrer to create the gel basis. The gelling agent and the microemulsion are prepared, and then the two are continually mixed until a microemulgel forms. Using various polymeric gelling agents, water in oil (w/o) or oil in water (o/w) microemulsion may be transformed into thick, semisolid microemulgels.[9]

To produce the gel base, dissolve the necessary gelling ingredient in distilled water

while stirring continuously. To create the microemulgel, the pH of the prepared gel is adjusted, and then the microemulsion system is gradually added to the gel at a certain ratio while being stirred continuously[9].

Preparation of Gelling Agent :

The goal of using a gelling agent in the formation of a microemulgel is to change its physical shape from liquid to semi-solid, which offers several benefits for patient compliance. In order to make different types of gel bases for gelling, the polymer can be added to purified water and continually agitated with a glass rod or any other appropriate mechanical device until the required texture is formed. Afterwards, the pH should be adjusted[22]. The polymer is added to purified water using a cold approach in a variety of experimental operations to prepare the gelling agent. The cold technique involves adding the ingredients to filtered water at 20 degrees Celsius, then adding the gelling polymer and cooling the water upto to 40^0C [23].

Incorporation of Gelling Agent :

A microemulgel is produced by mixing the microemulsion and gelling agent once they have been manufactured. Here, several polymeric gelling agents are used to transform a liquefied version of water in oil (w/o) or oil in water (o/w) microemulsion into a thick and semisolid microemulgel. This gel form can be transformed back into a solution form by rubbing or using another mechanical force. This material's characteristic is called thixotropy, and it allows for the transformation of gel to sol and sol to gel with the application of shear stress and its reverse, respectively, without causing a change in volume. Several polymers, including methyl cellulose, carbomer 940, carbopol 943, chitosan, carbopol 934, and carbopol 940, have been employed as gelling agents to create microemulgel with the appropriate properties for a range of uses.[24]

Gels based on Microemulsion were prepared by mixing 1g of gelling ingredient with enough distilled water. After placing this gelling agent solution in the dark for 24 hours, the entire swelling system is achieved. Next, while magnetic stirring is in place, the drug-loaded microemulsion is gradually added to the gelling agent's viscous solution.[12]

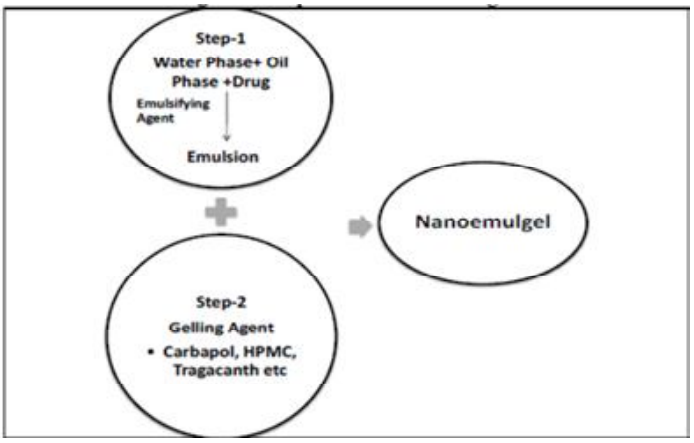

Figure 5: preparation of microemulgel[19].

Evaluation of Microemulgel :

1. Visual inspection : To determine the colour, appearance, and homogeneity of the produced microemulgel, visual inspection may be performed.[25]

2. pH measurement : The pH of a Microemulgel varies according to its intended application, such as on the skin or other mucous membranes. For example, the pH of human skin ranges from 4.5 to 6.

3. Determination of Viscosity : The gel's viscosity is essential for effective skin application. Comprehending gel's rheological behaviour is essential. The fluid's resistance to flowing is known as its viscosity; a higher viscosity is associated with a higher flow resistance. Fluids can be divided into two main categories: Newtonian systems and non-Newtonian systems. A higher viscosity fluid in Newtonian flow requires more force per unit area, or shear stress, to generate a given shear rate. At different shear rates, the viscosity in Newtonian flow remains constant. Unlike Newtonian fluid, non-Newtonian flow defies Newton's low viscosity and is unaffected by changes in shear rate[27].

4. Spreadability measurement : The medical efficacy of the suggested formulation will be determined by how well the topical medicine spreads. The ease with which a gel covers the affected area and the skin's application site is referred to as spreadability. Spreadability of a microemulgel is evaluated based on its "Slip" and "Drag" properties.[27]

5. Droplet Size Measurement and Polydispersity Index (PDI) : The dynamic light scattering (DLS) method is commonly used to calculate droplet size. The generated microemulsion's homogeneity of droplet size can be determined through the measurement of the polydispersity index (PDI).[28]

6. Zeta Potential : The combination of microemulsion and a gelling agent in microemulgel allows for the formulation to take on an electrical charge due to the presence of several surface-active components[29].

7. Drug content : Drug content is a crucial factor that determines how much drug is overall present in prepared formulas; a higher drug content is associated with minimal drug loss during the production process[30].

8. Accelerated stability study : The International Council for Harmonization's (ICH) guidelines should be followed when conducting an accelerated stability study. The formulations should be stored in the oven at 37±2, 45±2, and 60±2 degrees Celsius for three months. The samples in Press Azeez, Alkotaji: To ascertain the medication content, microemulgel should be checked every two weeks using the proper analytical method. The stability is determined by observing changes in the gel's pH or drug deterioration.[20]

9. In vitro release study: Drug release studies are conducted in vitro using Franz diffusion cell, which has an effective diffusion area of 3.14 cm^2 and a cell capacity of 15.5 ml . the diffusion cell's donor and acceptor chambers are encased in an even layer of the microemulsion that is applied to the membrane, to dissolve the medication, new phosphate-buffered saline (pH 5.5) is added to the

receptor compartment . a magnetic stirrer is used to stir the receiving chamber. Gather samples (aliquots of 1.0 ml) at appropriate intervals. Following the appropriate dilution, UV-Vis was used to determine the drug concentration of the sample. Calculate the total amount of medication that has been released via the dialysis membrane[12].

Applications of Microemulsion :

Microemulsion for oral route :

When poorly water-soluble drugs are administered orally, their solubility, absorption, and bioavailability are increased by the o/w microemulsion, which increases the drug's rate of dissolution and low bioavailability.

Microemulsion for ocular delivery :

To enhance the absorption of lipophilic medicines, such as erythromycin and pilocarpine, o/w microemulsion is utilized.

Microemulsion for nasal delivery :

When considering the nasal route in comparison to the perioral and parenteral routes, there are numerous advantages. For example, the nasal mucosa has more time to come into contact with the microemulsion droplet, which increases drug absorption, and the nasal route bypasses the liver's initial processing.

Microemulsion for transdermal delivery :

The chemical can penetrate the skin in three different ways: through sweat ducts, hair follicles, or the stratum corneum itself. these routes regulate drug absorption and bioavailability, enhancing drug targeting and redistribution across blood and lymph arteries. the capacity of nano-sized emulsion to enter skin pores and achieve systemic administration makes it a viable technology with benefits including minimal preparation costs, good storage stability, and thermodynamic stability.

Microemulsion in cosmetic :

Microemulsion is considered to be an excellent carrier for delivering cosmetics in a controlled manner and helps disperse active ingredients throughout the skin layer,because microemulsion does not sediment, cream, or flocculate, it is utilized in cosmetics[31].

Current and future prospects of Microemulgel :

As hydrophobic drugs are poorly soluble and bioavailable, developing formulations for them has proven difficult. Because of their hydrophobic oleaginous bases, topical formulations such as creams, ointments, and lotions have good emollient qualities but sluggish drug release. Topical aqueous-based formulations that provide an aqueous environment, such as gels, improve medication release. Oily bases and hydrophobic APIs are combined to create an emulgel, which is then nanonized to create a microemulgel with improved characteristics. Microemulgels are a great dose form because they provide sustained release, improved permeability, and thermodynamic stability. The process of creating nano-emulsions restricts their commercialization even with its benefits. But as technology advances, it may eventually be able to create manufacturing processes that

are both profitable and commercially viable. Because nano-emulgel has advantages over conventional formulations, there has been a massive surge in production of nano-emulgel can be foreseen[20].

Microemulgel is an integral part of the topical delivery system. The following are some of the several applications for microemulgel in topical delivery:

Topical microemulsion gel is a better option than conventional lipophilic drug formulations due to its improved pharmacokinetic profile, longer half-life, and increased therapeutic efficacy. Comparing the microemulgel formulation to other topical administration options, one of the primary factors contributing to its higher patient approval is its better spreading properties and less stickiness. Problems associated with standard emulsions, such as creaming and phase separation, are resolved and spared ability is enhanced by including Microemulsion into the gel matrix. A gel filled with microemulsion is more advantageous in certain topical situations. Topical Microemulgels are a more convenient and effective way to provide medication. Because the gel doesn't have an oily foundation, it releases medication more rapidly and has a greater patient compliance rate than other formulations. It is also non-greasy.

In the future, administering hydrophobic drugs may be accomplished more effectively and consistently with formulations based on microemulsion-gel. Many medications used to treat skin infections have hydrophobic properties. These medications can be effectively administered as microemulgels, in which the medicine is incorporated into the oil phase of the microemulsion before merging with the gel base. In spite of several obstacles, microemulgel is likely to be the mainstay for the topical administration of lipophilic medications in the future.[32]

It has been discovered that microemulgel is a very effective delivery system for hydrophobic medications. With greater drug loading owing to higher solubilizing efficacy, improved bioavailability owing to superior permeability, and the ability to control drug release, it's a powerful alternative delivery technique for treating a variety of ailments. It has been shown that using microemulgel formulation to treat psoriasis, rheumatoid arthritis inflammation, fungal infections, acne, and pimples is far more successful[33] In addition to transdermal use, it may be utilized for ocular, vaginal, dental, and nose-to-brain pharmaceutical delivery for the treatment of many local and systemic disorders such alopecia, periodontitis, and Parkinson's disease. Microemulgel has been utilized as a UV absorber in the cosmetics industry[34].

Topical microemulgels have proven to be a more beneficial option for a dependable and useful medication delivery system. The gel-like texture and lack of grease make the formulation more patient-complier, and the improved drug release results from not using oil as a foundation. Improved spread ability eliminates common emulsion issues like creaming and phase separation, and microemulsion-gel compositions may provide a more effective and reliable method of administering hydrophobic drugs. Hydrophobic medications are frequently used to treat skin infections, By first being incorporated into the oil phase of

the microemulsion and then combining with the gel base, these medications can be efficiently administered as microemulgels. Even with a few challenges, In the future, microemulgel is likely to be the primary topical delivery method for lipophilic medications. It provides multiple delivery options for topical drugs used to treat various conditions, such as high drug loading due to enhanced solubilizing efficiency and the capacity to modify drug release.

It has been discovered that microemulgel is an incredibly effective medication delivery medium for hydrophobic substances. Stronger drug loading because of increased solubilizing effectiveness, enhanced bioavailability because of increased permeability, and the capacity to regulate drug release make it a powerful substitute delivery method for treating a variety of illnesses.the microemulgel technology is incredibly versatile in treating a wide range of local and systemic illnesses.

The most efficient and useful medication delivery option has been found to be microemulgel topical. In comparison to other formulations, its gel-like and non-greasy qualities aid patients with improved compliance and oil deficit by offering superior medication release from the substrate.

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