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MICROEMULSION: A CUTTING EDGE STRATEGY FOR DRUG DELIVERY SYSTEMS

Ruchi Yadav[1*], Shekhar Singh[2]

[1,2]Department of Pharmacy, Suyash Institute of Pharmacy, Hakkabad, Gorakhpur, Uttar Pradesh, India

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Corresponding Author
Ruchi Yadav
Department of Pharmacy, Suyash Institute of Pharmacy, Hakkabad, Gorakhpur, Uttar Pradesh, India

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ABSTRACT

Purpose- Microemulsions are liquid mixtures of surfactants used, water-based, and oils which are isotropic transparent, &thermally steady often in combination through a co-surfactant. Method-Phasei Titrationi Technique Phase diagrams may be used to illustrate micro emulsions, which remain formed used the naturally occurring Emulsifying technique (also referred to as phases titrations method)7.10Drug solubility6000 rpm for 10min at room temperature following continuous stirring for 24 hours. Globule size and zeta potentiali. Utilizing a Zeta sizer HSA 30001Dilutes abilities test produced microemulsions are diluted in ratios of 1:101 and 1:1001. The "oil" might be a complex blend of different olefins and hydrocarbons, while salts and other materials could be present in the aqueous phase. Microemulsions create by merely mixing the components, in contrast to conventional oils, that required severe shear conditions to produce. Furthermore, the droplet size in these microemulsions is consistent, falling between 100 and 1000 A (10 and 100 nm), and Interfacial pressure between oil and water was remarkably low. Nowadays, the use of microemulsion in a variety of technological applications is a rapidly expanding business with global relevance. Since the droplet size of microemulsions is not as much of than 125% on the wavelength of observable bright, they remain glowing. Microemulsions in enhanced oil recovery Micro-emulsion for coating and textile finishing. Conclusions Micro-emulsion for detergency, small emulsion in beauty, small emulsion in agricultural products. Current And Future Developments Fluconazole Antifungal Topical, Piroxicam NSAID Topical drug delivery side This article attempts to illustrate the importance of microemulsions as DD Vehicles by giving a general review of their creation, characterization, and use in different drug delivery routes.

Key Words: *Microemulsion, Surfactants, Co-surfactants, Bioavailability.*

1. INTRODUCTION

A microemulsion It's one fluid solutions which is thermally stable and visually isotropic.based on water, oil, and amphiphiles. “The term "microemulsions" first appeared as 1959 by Jack H. Shulman. It is also known by the names easily visible emulsion, swelling micelle, micellar solution solubilized oil.An interfacial coating of surfactant molecules stabilises microemulsions, which are thermodynamically stable,clear solutions of oils and water.One can utilize a co-surfactant alone or in combination with the surfactant used, like a medium-chain alcoholic (butanol, pentanol). These uniform systems are all fluids with a low viscosity that may be produced in an oil: water ratio range of 20–80% and with surfactant concentrations ranging wide1.1 below(1)

Transparency, low viscosity, and more importantly, thermodynamic stable and spontaneous formation are characteristics that easily set microemulsions apart from regular emulsions·

A mixture consisting of three components at minimum is referred to as a micro emulsion: an aqueous form, an oily form, and a surface-active species, also known as surfactants. Co-surfactant is the fourth component that occasionally needs to or can be present. The microscopic structurs of the mini emulsions is at each of the extremes. varies according to the

component ratios. The microstructures of the micro emulsions range into oil phase dispersed in water phase (O/W micro emulsions) to extremely small liquid droplets scattered in oil phase (w/o micro emulsion).[2]

Thermally stable microemulsion systems with a minimum oil percentage of 30% that spontaneously form, 1. –30% non-ionized surfactant system with hydrophilic–lipophilic balance (HLB) consisting of 20% water, 9–18% co-solvent, and at least 30% oil. As a result, under typical circumstances, microemulsion systems have an infinite shelf life, in contrast to the limited life of macroemulsions. In addition, the droplets in these microemulsions maintain a consistent size within the range of 100-1000 A0 (10-100 nm) and exhibit a very low tensions at the water and oil interface. Microemulsions are transparent as their Just under twenty-five percent of the light that is visibles is made up of drops. wavelength[3],[4]

1. Types Of Microemulsions

Thermodynamically stable microemulsions are found only in specific, well-defined conditions. Winsor states that there are 4 different kinds stages of the microemulsions which can be found at various phases of equilibria sometimes referred to as Winsor stages. The following are four different methods of microemulsion solubilization that can be applied to pharmaceuticals. i.e., Water in oil type It exists in the continuing oil stage.droplets are scattered. Fatty acid tails face the oil phase, while the surfactant's polar headgroups face the water droplets. These are also called as "reverse micelles." The aqueous biological system can cause a w/o microemulsion that is administered orally or parenterally to become unstable.[5]

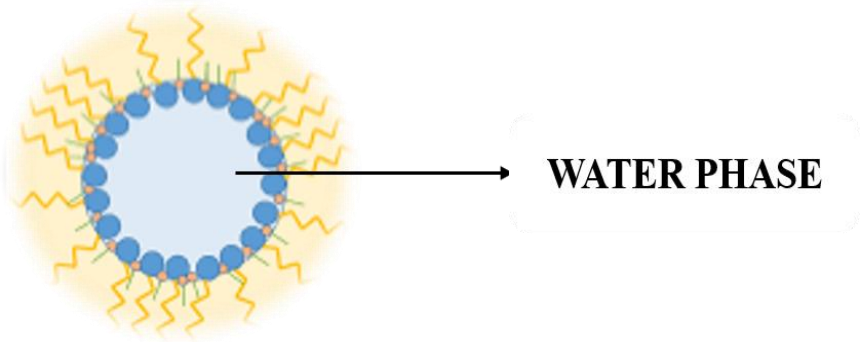


Figure 1 Water phase

1.1 Oil in water type - In the ongoing aqueous ph0ase, oil droplets are distributed.

Compared to w/o micro-emulsions this kind of tiny emulsion had a greater interactions ratio.

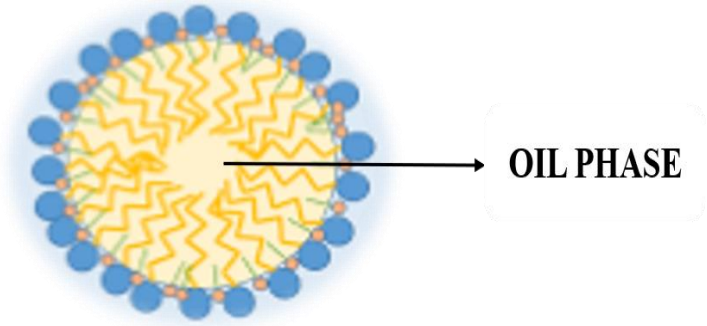


Figure 2 Oil phase

1.2 Microemulsions that are bicontinuous type-

Within the systems, there are pockets of water and oil and this instance, the phases of water and oil are both continuous. An uneven water and oil channel that resembles a "sponge-phase" is created. Transition oil-in-water for w/o conversion in micro-emulsion can cross these condition of discontinuity. Two-phase microemulsions can be plastic and flow non-Newtonian. They are particularly helpful for intravenous injection or topical drug delivery because of these characteristics.[6]

1.3 Homogenous Single-Phase Mixture type-

The oil, water, and surfactants are combined uniformly in a single-phase homogeneous mixture. [7]

2. Advantages of microemulsion system

1. The enhanced thermodynamic stability of microemulsions makes their production energy-free and simple.
2. The process of microemulsion production is reversible.
3. Temperature fluctuations can cause the microemulsion to become unstable, but it always returns to its stable range as the temperature drops.

4. In comparison to emulsions, microemulsions are less viscous.
5. Microemulsions are super solvents that may dissolve hydrophilic and lipophilic medications as well as drugs which are intractable in aqueous and polar solvents.
6. Able to transport hydrophilic and lipophilic medications.
7. Microemulsions are a thermodynamically stable system that enable the system to self-emulsify.[8]

3. disadvantages of microemulsion system[9]

1. Have a high surfactant requirement in order to stabilise droplets.
2. Having a restricted ability to dissolve highly combustible materials.
3. Environmental factors like pH and temperature influence the microemulsion'sstability.
4. It is necessary to have large concentrations of surfactant and co-surfactant

4. Theories Of Microemulsion[10]

There are three hypotheses about the creation of microemulsions these are-

4.1 Interfacial or Mixed Film Theory-

This theory is also known as a negative interfacial tension theory, postulates that when surfactant and co-surfactant interact, a microemulsion can form instantly and spontaneously, creating a negative interfacial tension. A films that could contain molecules or surfactants cosurfactants, is viewed a an oily "2 dimension" 3rdstage thats is balance through oil as well as liquid.[11]

A monolayer that has different characteristics on its water and oil sides is called a duplex film. The double-layer theory of films states that tension is present. between two surfaces γt may be found using the formula that follows.

$$\gamma.T = \gamma.(o/w) \text{ --- } \pi$$

Where, γ (o/w)

γ(o/w) An is a great deal less thans

γ(O/W) in the absence of the alcohol.

Improvement of clopidogrels soluble by the establishment of a micro-emulsion that (Patel V, Kukadiy H, Mashr R, Surti N, Mandals S.).

4.2 SolublizationTheory-

Micelleses inside micellar expand & increase progressively up to a variety of sizes. forming a microemulsion. These micelles might be oil soluble phase or reverse micelles.

4.3 Thermodynamic Theory-

A simple thermodynamic process can explain the formulation and micro-emulsion consistency. Therefore, extent to which An surface-reducing surfactants pressure at the point at which the two substances meet and a entropy shift of system can affect the unrestricted energy of microemulsion production. that is,[12]

$$D.G.f = \gamma.D.A - TDS$$

Where ,DGf = Formation's Natural Electricity,

γ =0il-water contact interfacial tensions,

DA = Modification of the interface region during micro-emulsifications

DS = shift in the system's overall entropy, which is essentially a dispersions entropys, and

T= Temperatures.

Its shown thatsa production the formation of the micro-emulsion is an enormous number of really small droplets, which drastically modifies the DA. Though γ is usually positive, it is vital to realize that it is really small. and is compensated for through the entropies factor.The main beneficial the influence of entropy comes from the extremely A high degree of dispersal that is produced when one phase mixes with the other in the form of many little droplets. [13]

5. Composition Of Microemulsion

A range of materials are used in the development and formulation of the microemulsions. Surfactants that are & oils are the primary elements needed to create microemulsions.

They ought to be non-toxic, biocompatible, and approved by doctors. These are the main parts of a microemulsion. Mainly, microemulsions contains[14]

A. Oil Phase
B. Aqueous Phase
C. Surfactant
D. Co-Solvent

Therefore, these all are briefly explained as-

5.1 Oil phase

Stage of oil is a 2nd subsequent most important vehicle afterwardliquid because it can dissolve a lipophilic molecule of drugs and improve absorption across body fatwall. Oil has a special ability to penetrate cell membranes, which makes it highly helpful for administering lipophilic active drugs. The tail of groups area inflation of the surfactants is influenced by the oily phases. For examples- lauric acid, oleic acid, capric acid[15]

5.2 Aqueous Phase

Hydrophilic active agents &preservatives are typically included in the aqueous phase. As aSolutions of buffers can be utilized in the water stage.

5.3 Surfactants

To stabilise a system, surfactants are employed. when creating the microemulsions. Reducing the interfacial tension is the function of surfactants. Surfactants surround the droplet in a microemulsion formulation, which is the last step in the dispersion process. These surfactants might be non-ionic, anionic, zwitter ionic, or anionic. [16]

5.4 Co-solvent

The polyethylene glycol (PG), ethane, and other solvent that are organic in polythene ethanediol (PEG) are examples of co-solvents. which aid in the dissolution of lipid-soluble medications and surfactants at relatively high concentrations. As a result, co-solvents and co-surfactants are synonymous terms[17]

Table 1Comparisons B/W Emulsion and Microemulsion

Emulsion	**Micro-emulsion**
	
These are the familiar micro-emulsions are of water in oil (water in oil) or oil in water (oil-in-water)	A microemulsion is a type of mixture that is thermodynamically steady. Microemulsions used for better drug absorption and bioavailability
Formed by mixing oil and waterwith the help of high shear conditions for their creation.	They do **not require high shear conditions** for their creation.
❖ The oil and water phases remain separate unless an emulsifying agent.	Microemulsions consist of tinydrops scattered in a single step within another phase. ❖ ThreeThere are many fundamental forms of tiny emulsion: ❖ **Direct Microemulsion (o/w)**: Oils droplets spread in Water ❖ **Reversed Microemulsion (water inoil)**: Waters droplets dispersed in oil. ❖ **Bicontinuous Microemulsion**: A continuous network of both oil and water phases.

6. Method Of Preparation Of Microemulsion:

1)Phase titration technique

2)Phase inversion technique

6.1 Phase Titration Technique:

Phase diagrams may be used to illustrate micro emulsions, which remainformed used the naturally occurring Emulsifying technique (also referred to as phases titrations) method). Phase diagram construction is a helpful method for researching the intricate web of interactions that might happen when several substances are combined. Depending on the chemical makeup and concentration of each component, different association structures such as an emulsion micelle, lamellar, hexagonal, a cubic, and other gels as well as oils dispersing are created along with micro emulsions.Crucial components of the study include determining their state of equilibrium and phase boundary delineation. Pseudo-ternary phase diagrams are frequently created to identify the various areas, which include the micro-emulsion zone, where each of the corners of the graphic indicates 100% of the individual ingredient. This is simple.quaternary phase diagrams, which represent four component systems, are laborious and challenging to comprehend. The area may be characterized as w/o or o/w micro emulsified depending purely on its the substance, that is, rich in water or oil. Care should be taken while making observations to make sure that no metastable in nature systems are mentioned[18].

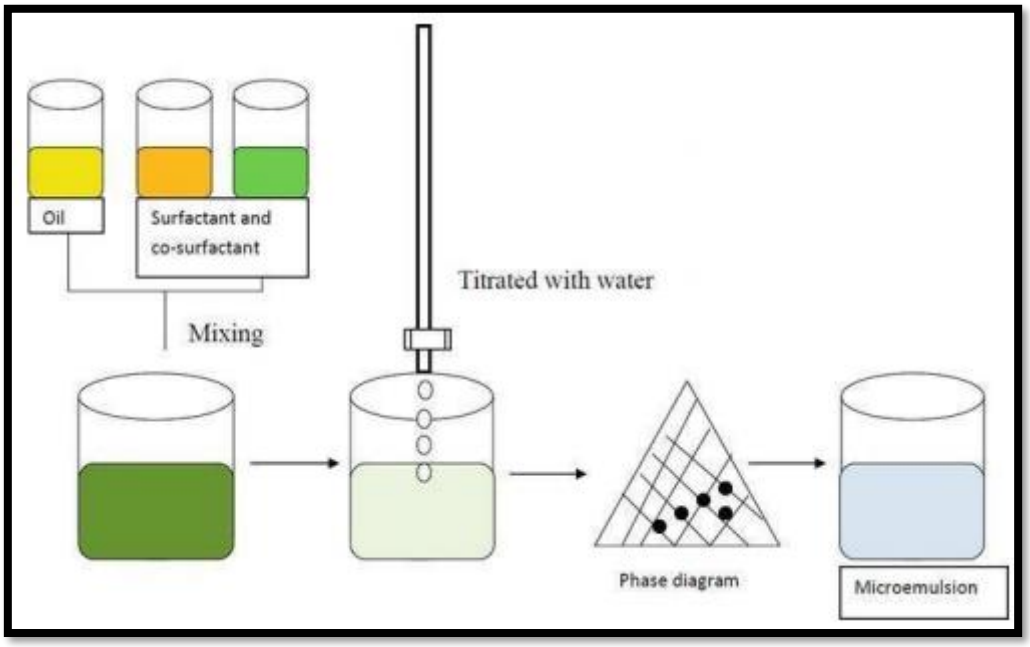


Figure 3:Phase titration method

6.2 Phase Inversion Technique:

Micro-emulsion experience an inversion of phase. when too much of a dispersed phase is added or when their temperature changes. Significant physical alterations, such as modifications changes particle size, occur following stage an inversion, and can alter medication released in vitro. well as in vivo. These techniques include adjusting Curved surfaces of the surfactants occur spontaneously. This may be done using non-ionic surfactants by altering the temperatures of the system., which will force an o/w micro emulsion to shift from a low-temperature state to a high-temperature one (transitional phase inversion). Finely distributed oil droplets are encouraged to develop when the system reaches an angle of Upon cool, there is no spontaneously curving and a minimum of tension on the surface. The inversion of phase the temperature, or The PIT technique is the term that refers to this. technique. Further factors, as the pH level or salt content, may be taken into account in addition to the temperature. Furthermore, by altering A water capacity fractions, a change in the spontaneously circle of curved. may be generated. When water is added to oil gradually, droplets of water first develop in an uninterrupted oil phase. A surfactant spontaneously curving changes from initially establishing a water in oilsmallemulsified an o/w small emulsified around the invers ion locus as the water volume percent is increased. By bridging a threshold between zero spontaneously curvature and low surface tension, brief-chain surfactants m facilitate the development of finely distributed oil droplets. Create a pliable multilayer at the o/w contact, which at the inversion produces a discontinuity the microemulsion[19]

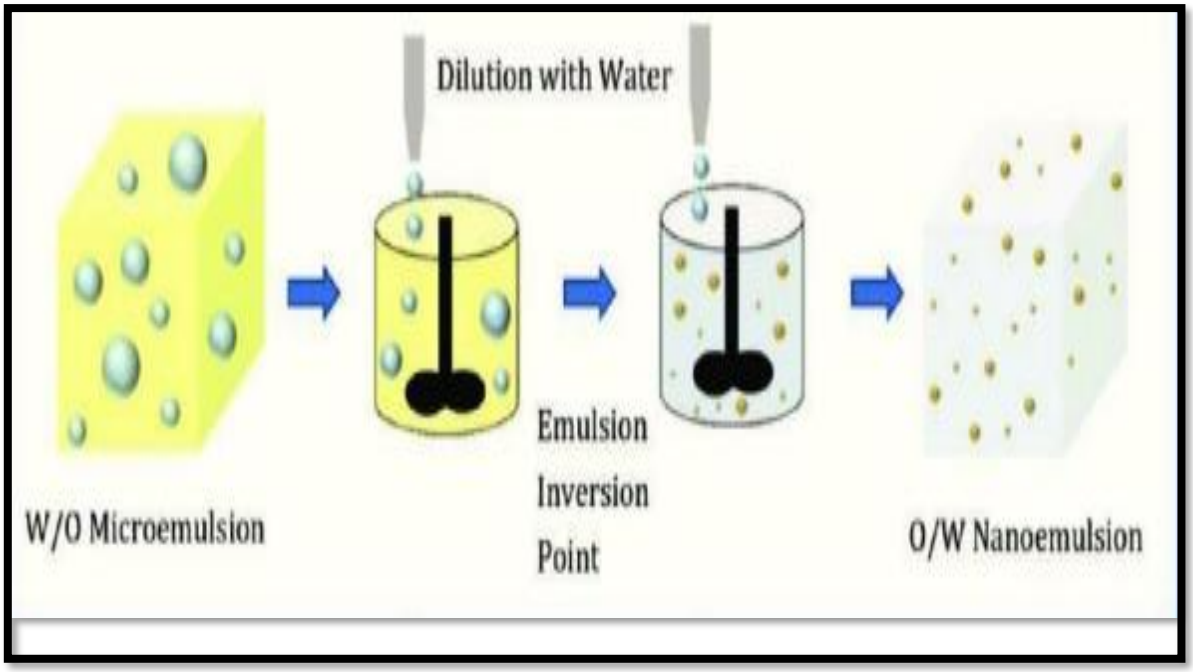


Figure 4ternary phase diagram depicts various structures.

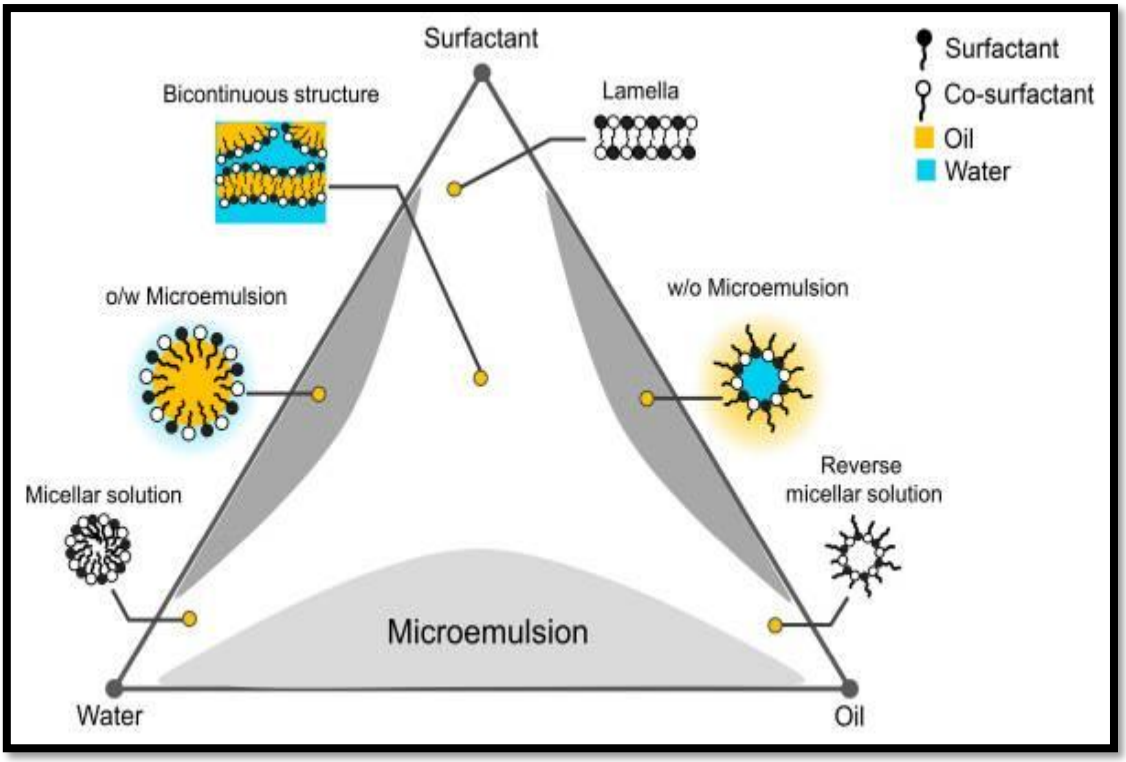


Figure 5 Phase inversion method

7. Evaluation Parameters Of Microemulsion System [20]

- **Phase behaviours**
- **Sizes and shape**
- **Physical appearances**
- **Scattering Techniques**
- **Limpidity Test (Percent Transmittance)**
- **Drugsstabilities**
- **Globule size and zeta potential measurements**

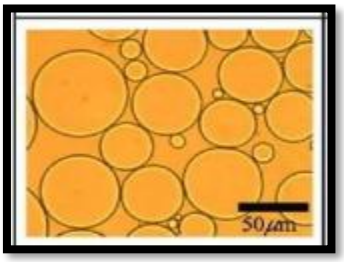
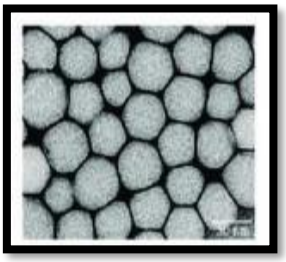
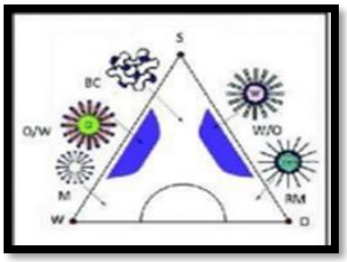
- **Assessment of the Rheological Property (viscosity measurement)**
- **Electricals conductivity**
- **Drug solubility**
- **In-vitro drugs release**
- **Electrons Microscope Characterization**

7.1 Phase behaviour:

In beauty products, violet Volatile oil is frequently utilized by way of a bioactives ingredient. To assess the impact of co-surfactant type on capacities. of micro-emulsion systems to dilute, the pseudo -ternary phase diagrams of microemulsions consisting water, non-ionic surfactant (Tween 80), and oilsstage (LO: small-chains alcohol = 1:1, w/w) were created in this work. When 1, 3-butylene glycol was present, the dissolution of LO was enhanced. Due to this, the Microstructural inverting of water quantitation point D82. was examined using DSC, viscosity, conductivity, and dye diffusion. At 20% water contents, microemulsions changed from Water/Oil to bi-continuous, and at 50% water content, they switched to an O/W structure. As the temperature rose during the bicontinuous phase, its viscosity quickly decreased.The activity of scavenging free radicals was impacted by the structural shift. With water contents ranging from 10% to 90%, the DPPH radical scavenges constantly, suggesting that adding more free water might quicken the chemical reaction between LO and DPPH radicals. In O/W areas, the concentration-dependent ABTS radicals-scaling capacity of the W/Ov& bi-continuous formulation increased and peaked at 70% water content. The use of microemulsion techniques as possible transfer methods might enhance the administration of insufficiently soluble vital

7.2 Size And Shape:[21]

Table 2Comparison with Macroemulsion, Nano-emulsion and Microemulsion

Content	Macroemulsion	Nano-emulsion	Micro-emulsions
			
Sized	1-100 um	20-500 nm	10-100 nm
Shapes	Spherically	spherically	sphericallylabelling
Stabilities'	Thermodynamic	Thermodynamically Unbalanced, kineticsconstant	Thermodynamicalconstant
Method of preparation	Highest& low-slungenergise methods	High andlow-slung energise methods	low-slung energise methods
Polydispersities	After highest (≥40%)	After high (≥1020%)	After high (≥10%)

7.3 Physical appearance[22]

Microemulsion's physical characteristics, such as homogeneity, flexibility, and optical simplicity, may be examined visibly.

7.4 Scattering Techniques[23]

The microemulsion structure studies have found use for scattering techniques like Lights the scatter low-angle X-ray scatter, and small angle neutron scattering, especially for dilute monodisperse zones and polydisperse or cantered systems like the ones commonly found in micro-emulsion

7.5 Limpidity Test (Percent Transmittance)[24]

the instrument can assess the limpidities of the micro-emulsion. using spectroscopy.

7.6 Drugsstabilities[25]

Three different temperatures were maintained for the optimal microemulsion: room temperature, 50 ± 2 °C, and cold (4-8 °C) The tiny emulsion can be evaluated for separation of phases and globule shape. % transmission, & % examine on a monthly basis.

7.7 Globule size and zeta potential measurement [26]

Utilizing a Zeta sizer HSA 3000 , dynamic sunny dispersion may be used to assess the globule shape the potential for zeta of the tiny emulsions.

7.8 *Assessment of the RheologicProperties (viscosities measurement)* [27]

Rheologically characteristics are crucial for stability. The digital viscometer made by Brookfield may identify it. It is possible to identify the microemulsion area and distinguish it from other parts by examining changes in the rheological properties. Bicontinuous microemulsions are dynamic formations in which there are constant changes among the swelling reverse micelle, swollen micelles, which are and bicontinuous structure.

7.9 Electrical conductivity[28]

At conductometer may be used to evaluate the electrical conductivity of formed samples at room temperature and a fixed frequency of 1 Hz. The water phase was introduced drop wise to an oil-surfactant-co-surfactant combination.

7.10 Drug solubility [29]

Both the optimised the microemulsion mixture and all of the formulation's component ingredients received excessive doses of the drug. Sample have been collected &centrifuge .at 6000 rpm for 10min at room temperature following continuous stirring for 24 hours. By The amount of dissolved drug in the sludge is calculated by subtracting from the total quantity of medication add. optimized mixture and separatelyseparate constituent in the invention were determined. a drugsolubility in a microemulsion was compared to that of each of its constituent parts.

7.11 Invitro drugs released[30]

Diffusions research mayThis is done in a 20 ml quantity used a customized Franz filtration cell. The receptor chamber had buffer inside of it. The donor chamber was made whole using

7.12 *Electron Microscope Characterization*[31]

the examination of the microstructure of microemulsions. The transmission electronmicroscopy (TEM), that can immediately produce high-resolution pictures and capture any coexist structure as well as micro structure alterations, is the most important technique.

The material is imaged at room temperature (RT) using the freezing fracturing TEM technique. The samples are then studied using the cryo-TEM following fructose freezing in a cold microscope and fast freezing.

8. Limitations Of Microemulsion[32]

A few things that restrict the application of the microemulsion in therapeutic settings. Among these are

1. Anumberthe number of surfactant & co-surfactants utilized must be kept small for toxic reason phase separation is another problem for microemulsions.
2. The need for pharmaceutically approved chemicals Limitations the selection of tiny emulsion ingredients (oil, surfactant used, co-surfactant), which poses difficulties in the formulation process.
3. Excipient toxic effects, or the harmful effects of surfactants and co-surfactants, is the primary drawback. The development of studies in this field may be aided through looking at safe excipients as well as assessing the toxicity characteristics of excipients currently in use.

9. Identification Tests For Microemulsion[33],[34]

9.1 Dilution test

The following stage will not separate or break if it is applied in microemulsions. It will remain stable if water is introduced to the o/w kind of microemulsions.

9.2 Staining test[35]

Water-sol bling dyes like Methanol blue or amaranth is included, on an oil-and surfactant micro-emulsion is produced. Microscopically, a drop of microemulsion can be observed. The backdrop is revealed to be either blues or red, while its globules might look colourless.

9.3 Dilutes abilities test[36]

To determine if there are any indications of separation in the system, the produced microemulsions are diluted in ratios of 1:10 and 1:100 While utilizing two-distil water.

9.4 Zeta potential measurement[37]

It is destructive and illogical, signalling the fact that the micro-emulsion droplets are not charged and that the infrastructure is reliable. The potential for zeta is calculated with zeta sizer. The potential is most effective for evaluating the flocculation since electrical charges are placed on nanoparticles alter the flocculation rate.

9.5 Poly dispersity[38]

Abbes refractometer is used to describe this characteristic.

10. Microemulsion Applications In Formulation[39],[40]

10.1 Controlled release solid state microemulsion:

The controlled-release products are produced from microemulsions, which are dispersed in a carrier and thoroughly mixed. The drug is then released in a controlled manner from the solidified microemulsions when the solvent is eliminated using techniques like spray drying, reduced pressure evaporation, etc·

10.2 Nanocapsules from w/o microemulsions[41]

The advantages of interfacial polymerizations of w/o micro-emulsions over other approaches in the preparation of PECA nanocapsules may have consequences for preserving stability and obtaining effective trapping of specific bioactives,particularly proteins and peptides. By adjusting some of formulation variables, which include the volume of polymer used, the water weight percentage of the aqueous component of the microemulsion, and the pH22, it is possible to control the size, wall thickness, polymer molecular weight, and release rate of the nanocapsules. Anju Graf et al. also described the interfacial polymerization process used to create insulin nanoparticles from w/o microemulsions.

Nanosuspension: Michele Trotta et al. describe the synthesis of griseofulvin particles from water-dilutable microemulsions. This nanosuspension may be made by using optimal formulations and medicinally appropriate solvents that are such as butyl lactate; low polydispersity griseofulvin nanoparticles smaller than 100 nm were attained. Grizeofulvin particles made using the solvent diffusion approach dissolved more quickly than those made using the commercial product.

11. Application Of Microemulsions System

11.1 Microemulsions in Pharmaceuticals[42]

Throughout a past twenty years, used of the micro-emulsion system for various pharmaceutical products has revolutionized the field.

11.2 Parenteral Delivery [43]

Because of the incredibly little quantity of medicine that is actually delivered to a target place, injecting (Especially via the intravenous route.) pharmaceuticals whose permeability was a large concern in manufacturing. Due of the tiny granular tiny emulsion is removed slower that's medium element emulsified & has a lengthier residences period in the bodies, the microemulsionspreparations offer unique profitsended macroemulsion solutions when supplied via ingestion.

11.3 Oral Delivery[44]

Compared to traditional oral formulation, the microemulsion formulation have a number of advantages, such as better clinical efficacy, lower drug toxicities, and improvedcaptivation. Consequently, its suggested that micro-emulsion are the best way to distribute drugs such chemicals, steroids, antimicrobial agents, and diuretics.

11.4 Topicalsdeliveries[45],[46],[47]

One benefit of topicals medication delivery over additional techniques is a avoidance of the drug's hepato metabolism in its first pass, salivary breakdown, abdominaldeprivation, and associated adverse effects. Alternative is the medication's capacity to be delivered directly to the eye or skin where it is needed. A lot of research has been done recently on the topic of medication absorption via the skin. They have the ability to improve the penetration of both lipophilic (finasteride, ketogenic profanity) and hydrophilic (flurouracil, apomorphine chlorine hydrochloride, etc.) medications. Since a high surfactant attentiveness is compulsory for the generation of microemulsions, skin irritation must be taken into account, particularly if the products are intended to be delivered over a lengthy period of times.[35]

11.5 Ocular and Pulmonary Deliveries[48],[49]

Medications are mostly administered topically to treat eye illnesses. Micro-emulsion has being examined for ophthalmic administration, for dissolving insoluble medicines, to increase absorption, and to provide a prolonged released profile. submitted for a longer time frame.

11.6 Pharmaceutical applications for current review[50],[51]

- ***Intranasal delivery***
- ***Drugs and cell targeting***
- ***Mind and periodontal delivery***
- ***Tumour targeted.***

12. Other application

12.1 Micro-emulsionin Analysis applications [52]

Micro-emulsion is frequently employed in analytically methods like chromatograms, among others. Characterization of solvent hydrophobicity was done used microemulsions electrokinetics chromatographic (MEEKC), which offers a rapid and reliable way to determine the solvent has hydrophilic properties. Micro-emulsion can be utilized to improve analytical spectroscopy by acting as a solubilizing medium, spectra shift reagents, intensity augmentation agents, and so on. The analytic sensitivity of all three systems—o/w, w/o, and bi constant microemulsion—as well as the use of microemulsion

medium in analytic spectra have been investigated. Several studies have been conducted to determine the concentrations of aluminum, zinc, copper, and manganese ions using both mixed microemulsion and microemulsion systems.

12.2 Micro-emulsions in biotechnology[53]

Aquo-organic, pure natural, and alternating mediums are used for a variety of biocatalytic and enzymatic procedures. Due to their ability to denature or inactivate the biocatalysts, their Utilized is severe restricted. Recent, there has been a focus on micro-emulsions for a variety of biotechnological applications, including bio separation, proteins immobilization, which and enzyme reactions.

12.3 Microemulsions in enhanced oil recovery[54]

Unrecoverable subsurface oil can be obtained by comprehending the mechanics of enhanced oilsrecoveries, or EOR, using surfactant &tiny emulsion. Aimportanthelping to the residual oil trapped in the porous medium can be mobilized if the pressure in the interface across the crude oil or reserve brine can be lowered. to around 10-3 N/m. It is also beneficial that the system has low interfacial stickiness.

- **Micro-emulsion to Bio Separating**
- **Microemulsion as a chemical sensor material**
- **Micro-emulsion serves as lubricants, and cutting oils, and corrosion inhibitors.**
- **Micro-emulsion for coating and textile finishing.**
- **Micro-emulsion for detergency.**
- **Small emulsion in beauty.**
- **Small emulsion in agricultural products.**
- **Micro-emulsion in food.**
- **Micro-emulsion for environment cleanup and detoxification.**
- **Developed microporous medium using the microemulsion gel process.**
- **Micro-emulsion used in applications for analysis.**
- **Small emulsion are liquid membrane.**
- **New crystallized colloidal array as biochemical sensor materials.**

13. Current And Future Developments[55]

Over the past 20 Many years of studies have been undertaken on the microemulsion system in an effort to find novel solutions for the problems of repeated bioavailability and low solubility in water of highly lipophilic pharmaceutical compounds. Scaling up is easy from an industrial perspective when evaluating the comparative costs of profitable manufacturing.

A micro- emulsion can be using cosmetically &to target medications. The focus of current research is on developing safer, more appropriate, and effective microemulsion ingredients to extend the use of this cutting-edge delivery method.

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Table 3 Drug Category and route

S.NO	Drug	Category	Route
1	Fluconazole	Antifungal	Topical
2	Piroxicam	NSAID	Topical
3	Acyclovir	Antiviral	Topical
4	Acetogenic	NSAID	Percutaneous
5	Fluconazole	Antifungal	Topical
6	Diclofenac Sodium	NSAID	Transdermal
7	Timolol	Antihypertensive	Ophthalmic

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