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Original Article

A Review On: Microemulsion

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ABSTRACT

The unit of micro-emulsions mixes with at least one hydrophilic, one hydrophobic, and one ampiphilic half that are optically and macroscopically isotropic. These are clear, unit stable compared to other emulsion forms, and typically used in conjunction with a co-surfactant. Their diameter falls between 10 to 140 µm. These days, micro-emulsion formulations are widely used to deliver hydrophilic medications; however, because lipophilic medications act as drug carriers, they require a number of additional fantastic properties, such as long half-lives, improved bioavailability, preparation comfort, ultra-low surface tension, and large surface area. Because of their extended shelf life, improved drug solubilization, and ease of preparation and administration, microemulsions are a popular choice for innovative drug delivery devices. Oil, water, and amphiphile solutions that are thermodynamically stable are called microemulsions. They have become new. vehicles for drug delivery that enable parenteral, topical, transdermal, ocular, and percutaneous drug administration with controlled or sustained release. It is easy to distinguish microemulsions from regular emulsions due to their low viscosity, transparency, and—most importantly—thermodynamic stability.

Keywords: oil, co-surfactant, Microemulsion, Thermodynamically Amphiphile, Solubilization, Microemulsions, stable

INTRODUCTION

The definition of a Microemulsion is a transparent, stable, isotropic liquid mixture of water, oil, and surfactant, or a combination of these substances. In pharmaceutical research, creating a new drug delivery system with the goal of increasing efficacy is a continuous process. Since then, numerous medication delivery system kinds have been created. By dispersing oil, aqueous surfactant solution, and micro emulsion using polyethylene glycol as a co-surfactant, they created the first micro emulsion, which produced a stable and transparent formulation. Over time, there has been a lot of interest in microemulsions as possible drug delivery vehicles. Several characteristics of micro emulsion-based formulations include improved drug solubilization, strong thermodynamic stability, and simplicity of production. Drug delivery can be accomplished in a number of ways with microemulsions, which are flexible systems. Numerous studies have been conducted on these systems for topical delivery. Microemulsions can improve systemic or local drug delivery as a topical carrier by using a new method. The tiny emulsion Because it can improve drug solubilization, it is an excellent option for oral delivery of weakly water-soluble medications. As a drug's thermodynamic activity in the vehicle increases, so does its absorption rate. Emulsions are essential to a lot of the cosmetics we use today. Over the years, a lot of literature has been produced regarding the development and stability of these water-dispersed (o/w) or water-dispersed oil systems (without). Nonetheless, the cosmetic formulator continues to strive to comprehend and produce the most aesthetically pleasing and useful Micellar emulsion, also known as Microemulsion, is a dynamic system in which the interface fluctuates continually and spontaneously. They can be classified as bi-continuous microemulsions, water in oil (W/O), and oil in water (O/W). Maintaining the interfacial layer's flexibility in W/O forms lowers interfacial tension. Water droplets are distributed in the continuous oil phase to produce microemulsions, whereas oil droplets are distributed in the continuous aqueous phase to form O/W micro emulsion identified four types of equilibrium micro emulsion phases, which

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are referred to as Winsor phases. These phases are as follows:

A. Winsor I: The lower o/w micro emulsion phase and the upper oil layer are in balance in this two-phase system.

B. Winsor II: The two-phase system's upper microemulsions (w/o) and lower excess water equilibrium are in balance. The middle bicontinuous phase of o/w, known as W/O, is in equilibrium with the upper oil phase and the lower water phase.

C Winsor III (triphasic system). The single-phase system

D. Winsor IV: Creates a uniform blend of water, oil, and surfactant.

Composition:

The micro emulsion system is composed of the following primary parts:

1) Oil stage
2) Primary surfactant (surfactant)
3) Co-surfactant, also known as secondary surfactant.
4) Phase of Co-solvent:

1) Oil:

The oil phase is the second most significant vehicle after water because of its ability to improve absorption through the body's lipid barrier and solubilize lipophilic medication molecules.

Example: Lauric, Myristic, and Capric acids are saturated fatty acids. Oleic, linoleic, and linolenic acids are unsaturated fatty acids. Lauric, myristic, and oleic acid esters can be either ethyl or methylated to form fatty acid esters.

2. Surfactants:

To help all of the components disperse, the surfactant used in the microemulsions preparation process needs to be able to keep the interfacial tension as low as feasible. These surfactants include: Cationic Zwitterionic, Anionic, and Nonionic. The following are examples: Polyoxyl 35 hydrogenated castor oil (Cremophor EL) and Polyoxyl 40 castor oil (Cremophor RHCo surfactants).

3. Co-surfactants:

High concentrations of single-chain surfactants were found to be necessary to reduce the o/w interfacial tension to a point where a micro emulsion can form spontaneously. One example would be short-chain alcohols, such ethanol to butanol. 2) Glycols with short chains, such propylene glycol.

4. Co-solvents:

These organic solvents, which include ethanol, propylene glycol (PG), and polyethylene glycol (PEG), aid in the dissolution of generally high concentration.

Advantages:

1. One benefit of micro emulsion is its long shelf life and thermodynamic stability.
2. The drug's super solvent is a micro-emulsion.
3. A possible liphophilic or hydrophilic drug reservoir.
4. When absorption occurs, the medication is released quickly in the external phase because of the small droplet size and high globule interfacial area.
5. The capacity to transport medications that are both lipophilic and hydrophilic.
6. It is simple to cook and doesn't demand much energy.
7. Low viscosity.
8. Beneficial for test masking.

The drawbacks of micro emulsion:

1) Need a lot of co-surfactant and surfactant to stabilize droplets.
2) Limited solubility for compounds with high melting points.
3) Environmental factors like pH and temperature affect stability.

Different Microemulsion Delivery Methods:

1) Oral Administration:

Compared to the conventional oral formulation for oral administration, micro emulsion formulations have a number of benefits, such as enhanced absorption, enhanced clinical efficacy, and decreased drug toxicity. With mild agitation, a self-emulsifying drug delivery system called "SEDDS"—a mixture of oil and a drug-containing surfactant—forms a micro emulsion of oil in water in aqueous media, which served as the model for this kind of delivery. One of the many variables influencing SEDDS absorption is the existence of bile salts. The quantity of bile salts integrated into the emulsion droplets' surfactant layers ultimately results in medication malabsorption.

2) Skin delivery:

This is the earliest method of administration to employ the micro emulsion technology. The dosage form's objective is to maximize flux via the skin when applied transdermally into the bloodstream. Microemulsions have been used to successfully administer lidocaine, apomorphine, estradiol, and ketoprofen transdermally. Studies on human skin irritation were conducted using lecithin liposomes and a lecithin micro emulsion gel. For a number of reasons, including avoiding first-pass hepatic drug metabolism and its related harmful consequences, dermal drug delivery may be superior to alternative techniques. The medicine is delivered directly to the organ that is impacted, which is the other benefit. Vaccines have historically been given by needle injection. Recently, there has been a lot of interest in topical vaccination using protein- or DNA-based vaccines through intact skin.

3) Ocular Delivery:

One of the most promising methods for employing the ocular route is the micro emulsion method. Ocular applications are better suited for micro emulsion formulations due to their transparency. Eye drops are the most popular method of delivery via the body, despite their poor bioavailability. identified a novel micro emulsion delivery system for topical dexametasone ocular administration. Microemulsions are potential delivery technologies for ocular medications due to their special qualities and many benefits. ME may enhance the drug's water solubility and enhance its absorption in the eye. The micro emulsion system demonstrated good stability and appropriate physicochemical behavior during a three-month period.

4) Ocular Drug delivery:

In traditional ocular dose forms, water-soluble medications are administered as aqueous solutions, whereas water-insoluble medications are prepared as ointments or suspensions. Among these systems' major issues are low corneal bioavailability and inefficiency in the posterior region of ocular tissue.

5) Nasal delivery:

In order to improve drug absorption through the nasal mucosa, microemulsions have recently been investigated as a delivery method. Additionally, the muco-adhesive polymer aids in extending the mucosa's residence period. Lianly et al. looked into how diazepam affected status epilepticus emergency care. They discovered that diazepam was rather quickly absorbed through the nose at a dose of 2 mg kg-1, with the maximal drug plasma concentration occurring in two to three minutes.

6) Parenteral Administration:

Giving medications by parenteral means, especially through an intravenous solubility is one of the main issues facing the industry because so little medication is actually transported to the intended location. Because fine-particle microemulsions are eliminated more slowly than coarse-particle emulsions and so have a longer residence time in the body, micro emulsion formulations offer clear advantages over macro emulsion systems when given parenterally. Microemulsions that are O/W or W/O can be administered parenterally. The physiological effects of pharmaceutical peptide and protein medications are highly selective and powerful, and they are challenging to take orally. Most protein medicines are only available as parenteral formulations because of their poor bioavailability.

Microemulsion preparation method:

There are two primary techniques described for creating the microemulsions.

1) Phase titration method
2) Phase Inversion method

Phase Inversion Method

In the phase inversion method phase inversion of microemulsions occurs by the addition of excess amount of the dispersed phase. During phase inversion quick physical changes occur including changes in particle size that can affect drug release both in vivo and in vitro. For non-ionic surfactants, this can be completed by changing the temperature, forcing a transition from oil in water microemulsion at low temperatures to water in oil microemulsion at higher temperatures (transitional phase inversion). During cooling, the system crosses a point of zero spontaneous curvature and minimal surface tension, promoting the formation of finely dispersed oil droplets. This method is also known as phase inversion temperature (PIT) method. Other than temperature, other parameters such as pH value or salt concentration may be considered more effectively instead of the temperature alone. Additionally, a transition in the spontaneous radius of curvature can be obtained by changing the water volume fraction. By successively adding water into oil, initially water droplets are formed in a continuous oil phase. By increasing the water volume fraction changes the spontaneous curvature of the surfactant from initially stabilizing a w/o microemulsion to an o/w microemulsion at the inversion point.

Phase Titration Method

Microemulsions are formulated by the spontaneous emulsification method (phase titration method) and can be shown with the help of phase diagrams. A mixture of fatty acid and oil is added to a caustic solution to prepare a microemulsion, then after it is titrated with a cosurfactant, an alcohol, until the system turned clear. Microemulsions are formed along with various association structures (including emulsion, micelles, lamellar, hexagonal, cubic, and various gels and oily dispersion) depending on the chemical composition and concentration of each component. It is found that as the chain length of the surfactant increased, microemulsions with significant transmittances by visible spectrum can be formed with oils of longer chain lengths. It is also found that different alcohols affect the formation of microemulsions in different ways. The best results, in terms of the greatest percent transmittance coupled with the widest range of oil (dispersed in water) concentration, are obtained from short or branched alcohols.

Formula:

Sr no.	ingredient	quantity	Uses
1	Azithromycin	500mg	Treat bacterial infection
2	Olive oil	15ml	Penetration enhacer
3	Tween 80	7ml	Emulsifier
4	PEG400	5ml	Humectant
5	Distilled water	q.s	vehicle

1) Using a water bath and magnetic stirrer, solubilize azithromycin in a beaker and first weigh an exact amount of olive oil.

2) Mix the cosurfactant and surfactant and add the oil phase in a different beaker. Blend well

3) An aqueous phase titration. Pour in water drop by drop while stirring continuously. Stir until a steady, transparent micro emulsion forms.

Evaluation of Microemulsion:

1) Appearance:

Microemulsions are usually somewhat opalescent and light yellow in color.

2) Determine the pH:

By precisely measuring 1 milliliter of prepared micro emulsion that has been dispersed in 10 milliliters of pure water. A digital pH meter was used to measure the pH. The pH of 5.7 of the preparation has been determined.

3) Viscosity:

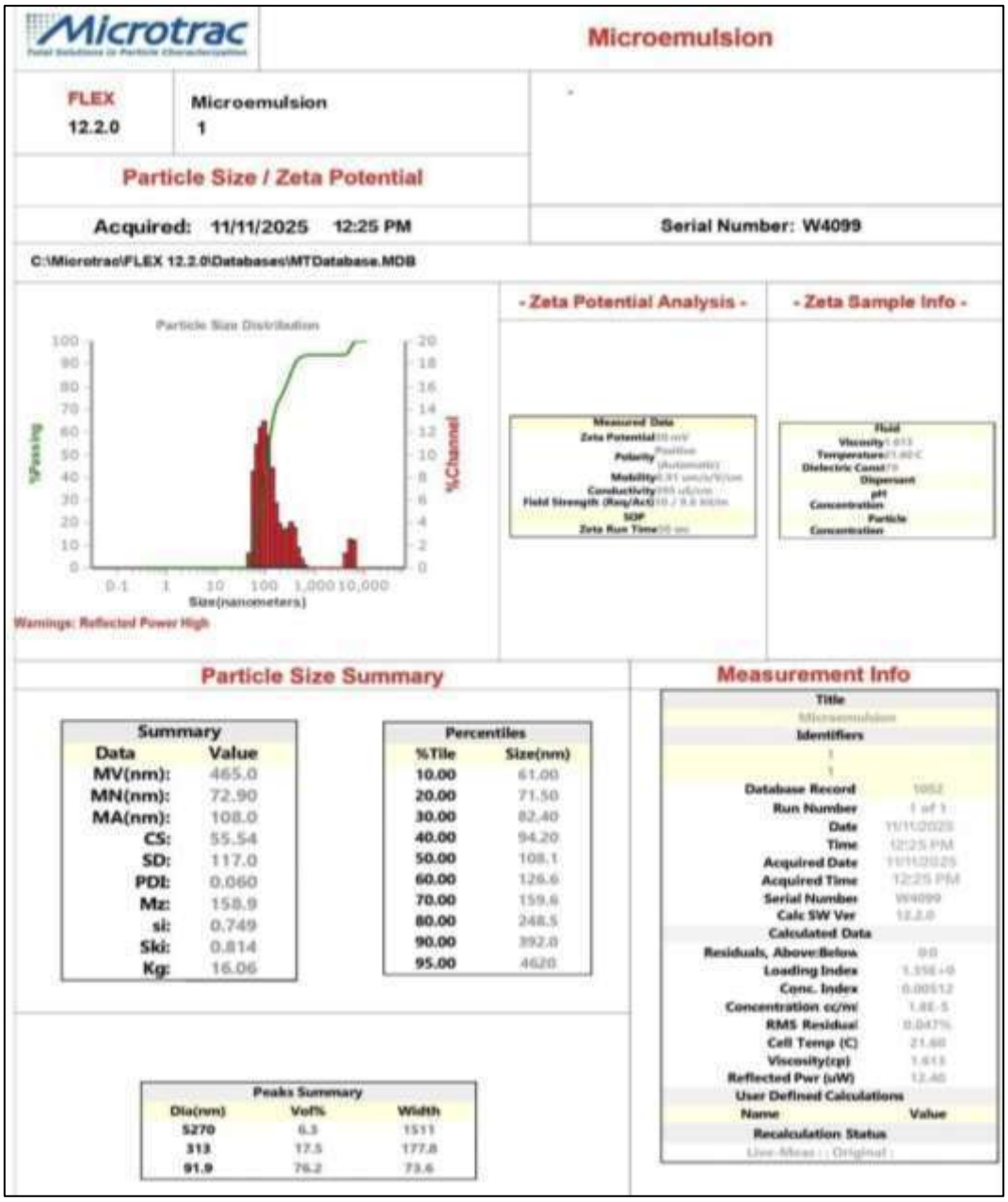
The preparation's viscosity (1.613 cp) has been established. The ability to distinguish between o/w systems (10 to 1000 uS/cm) and w/o systems (<10 uS/cm) is facilitated by conductivity. A conductivity of 395 uS/cm has been established for the preparation.

4) Drug content:

The formulation's determined amount of active pharmaceutical ingredient (API) using UV visible spectrophotometer. It was determined that the drug content was 98.80%.

5) Zeta potential

The formulation's stability and surface charge are indicated by the zeta potential. The general range of zeta potentials is +0 to +10 mV: Low stability (particles inclined to agglomerate) +Stability is moderate between 10 and +30mV High stability (excellent electrostatic repulsion) at 30mV or above.30 mV has been identified as the zeta potential.



CONCLUSION:

Drug delivery devices that distribute multiple medications at once are called microemulsions. Microemulsions have been shown to protect labile drugs, regulate drug release, improve drug solubility, boost bioavailability, and decrease patient variability. They have also made it feasible to create formulations that work with the majority of delivery routes. Microemulsions role in offering innovative ways to address the issues of highly lipophilic drug compounds' poor aqueous solubility and in delivering high, more reliable, and consistent bioavailability. In order to achieve regulated release with improved bioavailability and to target different parts of the body.

REFERENCE

1. J. H. Schulman et al. Mechanism of formation and structure of micro emulsions by electron microscopy. The Journal of Physical Chemistry 1959; 63: 1677–1680.
2. Aboofazeli R and Lawrence M.J. Investigations into the formation and characterization of phospholipid microemulsions. I. Pseudoternary phase diagrams of systems containing water-lecithin-alcohol-isopropyl myristate. International Journal of Pharmaceutics 1993; 93: 161-175.
3. JhaSajal Kumar et al. Microemulsions- Potential Carrier for Improved Drug Delivery.

Internationale Pharmaceutica Sciencia 2011; 1(2): 25-31.

4. Vyas S P. Theory and practice in novel drug delivery system. CBS Publishers New delhi. 2009; p115. [20]. Prince L. M. A theory of aqueous emulsions I. Negative interfacial tension at the oil/water interface. Journal of Colloid and Interface Science 1976; 23: 165- 173
5. Martin A. Coarse Dispersions In Physical Pharmacy. Fourth Edition B.I. Waverly Pvt. Ltd. New Delhi. 1994; p495. [22]. Rao Y.S. et al. Microemulsions: A Novel
6. The International Journal of Pharmacy and Pharmaceutical Sciences, Volume 5, Issue 3, 2013, Faizi Muzaffar and U.K. Singh Lalit Chauhan's review of micro emulsion as a futuristic drug delivery method is cited.
7. Vikesh Kumar Shukla, Pranjal Kumar Singh, Mohd. Kashif Iqubal, and Shuaib Review Journal of Pharmaceutical, Chemical, and Biological Sciences, February 2014; 1(1):39-51; Microemulsions: Current Trends in Novel Drug Delivery Systems.
8. Review Article by Kiran Panchal, Manjusha Dhondwad, and Supriya Shinde
9. Hoar TP and Schulman JH. Dispersions of transparent water in oil: Micelle oleopathic hydro-ersions. This is the first description of micro emulsion that we are aware of. Nature 1943; 152: 102-03.
10. Stéphane Gibaud and David Attivi, Oral microemulsions and their therapeutic uses, Expert Opinion on Drug Delivery, Taylor & Francis, 2012, 9 (8), epub before print. In 2012, 10.1517/17425247.694865.
11. Santosh Nemichand Kalel and Sharada Laxman Deore2, Comparison of Micro and Nano Emulsions, 40 Systematic Reviews in Pharmacy, Vol. 8, Issue 1, January–December 2017 In Current Drug Delivery, Volume 3, Issue 3, pages 267–273.
12. K.R. Jadhav, I.M. Shaikh, K.W. Ambade, and V.J. Kadam discuss the use of micro emulsion-based drug delivery systems.
13. A Handbook of Cosmetics, by Mithal BM and Saha RN. Vallabh Prakashan, Delhi, 1st Ed.
14. Dorabu N, Sabareesh M, Kotta K, and Sasikanth K. Formulation and assessment of diacerein cream. Asian Journal of Clinical and Pharmaceutical Research, 4 (2), 2011: 93–98.
15. Jain A, Gautam SP, and Jain S. Creation and evaluation of a gel based on ketoconazole micro emulsion for topical medication administration. 2010: 221-214.
16. Preparation and Assessment of Tretinoin Microemulsion Using Pseudo Ternary Phase Diagrams Anayatollah S, Moghimipour E, and Leis F. Bulletin of Advanced Pharmaceuticals.2 (2); 2012: 141-147.
17. Chen H, Weng T, Zhao X, Gao Z, Yang Y, Xu H, and Yang X. An investigation on micro-emulsion methods for triptolide transdermal delivery. Controlled Release Journal, 98, 2004: 427–436.
18. Jogani VV, Shah PJ, Mishra P, Mishra AK, and Misra A (2008): Tacrine intranasal mucoadhesive micro-emulsion to enhance brain targeting. Alzheimer's disease and related conditions, 116–124.
19. Karasulu E, Yavasoglu A, Evren_anal Z, Y, Uyan_kgil Histological analysis and permeation investigations of sheep nasal mucosa after various nasal formulations with or without absorption enhancers were administered. Karasulu HY, 219-225, Drug Delivery (2008).
20. Muco-adhesive Kumar M, Misra A, Mishra AK, Mishra P, Pathak K (2008) Olanzapine is delivered intranasally using a nanoemulsion-based method that targets the brain. Brain Targeting Journal, 806-814.
21. Li L, Nandi I, and Kim KH (2002) created a micro emulsion based on ethyl laurate for quick-onset intranasal administration of diazepam. Journal of Pharmacology International 7785.
22. Allen LV. Ansels Drug delivery systems and pharmaceutical dosage forms. The eighth edition. Juergen Siepmann and Alexander T. Florence, 2005.
23. Drugs and Pharmaceutical Sciences, Vol. 1 of Modern Pharmaceutics volume 188 Fifth Edition, 2009 Informa medical care.
24. Pant NC, Kumar K, Chauhan N. A current analysis of transfersomes, a brand-new vesicular drug delivery method applied topically. Pharmaceutical Research Universal Journal, 2017; 2(4): 42–45.
25. A thorough analysis of sustained release matrix tablets as a potentially effective dosage form was

conducted by Agarwal P and Semimul A. 3(6): 49–54 in the Universal Journal of Pharmaceutical Research, 2018.

26. Michael E. Aulton is the editor of Aulton's Pharmaceutics: The Design and Manufacturing of Medicines, third edition. Livingstone Churchill. 384, 2007; 390–405. 22. A recent review of topical otic dose forms delivered locally by Algin Yapar E, Beskan U, and Karavana SY. Pharmaceutical Universal Journal.

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