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MICROEMULSION: A REVIEW

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Abstract

Microemulsion are thermodynamically stable, transparent and isotropic liquid mixture which are consisted of oil, water and surfactant. The particle size of micro emulsion may ranges from 10 to 300 nanometers. Microemulsion are good candidates of as potential drug delivery system because of their long shelf life, ease of preparation, improved drug solubilization and administration. Microemulsion are thermodynamically stable and can be easily distinguished from normal emulsion by their low viscosity thermodynamically stability and transparency. The range of pharmaceutical applications of emulsion widened for emulsion has expanded, especially after since the introduction of micro and nano- emulsion. The aim of this review paper discussed in detail about microemulsion.

Key words: Emulsion, Micro emulsion, Nano emulsion, Surface tension, Zeta potential, Topical drug delivery system.

A. INTRODUCTION

Locally drug delivery system is widely used for drug delivery system. This system existed from ancient period of time to treat the disorders. Topical drug delivery system can be defined as the application of drug containing formulation to the skin to directly treat cutaneous disorders with the intent containing the pharmacological or other effect of drug to the surface tension of the skin or within the skin. Emulsion are dispersion made up of two immiscible liquid phases which are mixed using mechanical shear and surfactant.[1]

Micro emulsion is clear, thermodynamically stable, an isotropic liquid mixture. It that is prepared by using oil transparent and thermodynamically stable. Oil, water, surfactant and co-surfactant. It incorporates are used to make it. In comparison to traditional emulsion, it contains very small size particles up to nano size as compared to conventional emulsion, micro emulsion. Nano emulsions are very similar to micro-emulsion that are dispersions of nano scale particles but obtained by mechanical force unlike to micro emulsions which forms spontaneously.[2] The microstructure of the mixture changes continuously from one to another extreme, namely, from a spherical to cylindrical, tubular and interconnected continuous oil and water phases separated with a very discontinues micro emulsion is characterised as a thin layer of surfactant

molecules in the centre.[3] Each type of micro emulsion is a transparent, thermodynamically stable solution. There are main differences between emulsions and micro emulsions in terms of structure and stability. In contrast to micro emulsions, emulsions are inherently unstable systems that will phase separate without agitation.

The other difference is that the size of droplets in emulsions are in the range of micrometers, while in micro emulsions the size of micelles are in the range of 5-100 nm, depending on several factors including surfactant kind and concentration, as well as the level of dispersion. Hence, sometimes the micro emulsion term is misleading, because it doesn't reflect the size of dispersed phase droplets in the system which, are in the nanometer range.[4] Another key element that impacts the major properties of a micro emulsion is the presence of electrolytes in the aqueous phase, which depends on the type of surfactants used in the formation of the micro emulsion.

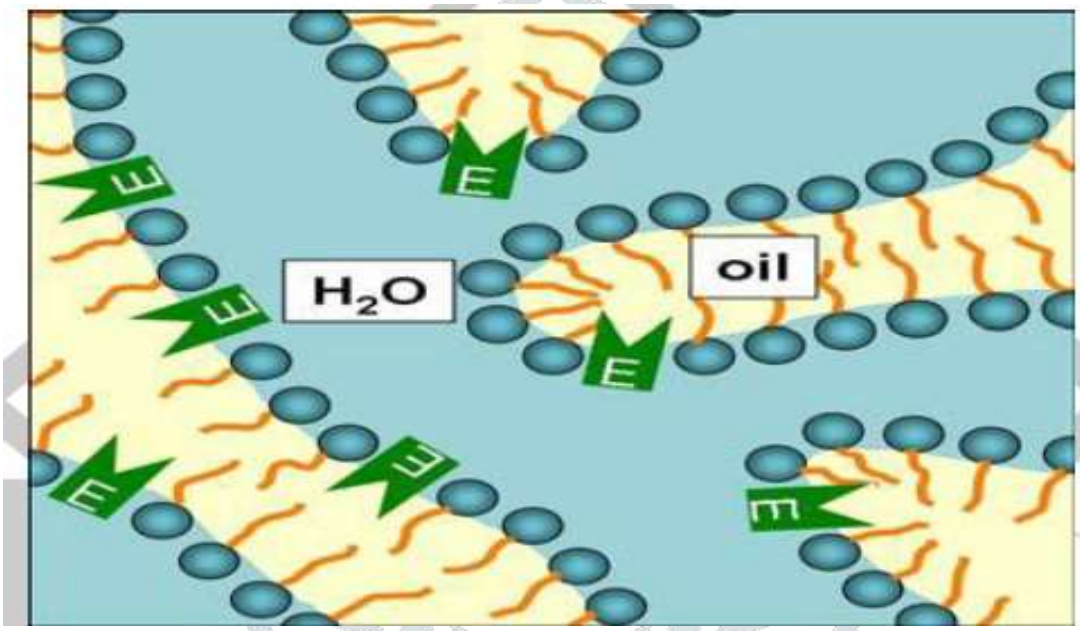

Fig.1. Micro emulsion structure

Important Characteristics of Micro-emulsions:[5]

- Particle size 10-100 nm
- Thermodynamically stable (long shelf-life)
- Small droplet Size
- High surface area (high solubilisation capacity)
- Optically Clear
- Enhanced drug solubilisation
- Ease of formation (almost spontaneous formation with no interfacial tension).
- Ability to be sterilized by filtration
- Long-term stability
- High solubilisation capacity for hydrophilic and lipophilic drugs
- Improved drug delivery

B. Micro-emulsion as Drug Delivery Systems:[6]

a) Oral drug delivery

The most common method for drug delivery is through the oral route as it offers convenience and high patient compliance.

b) Transdermal Drug Delivery

One of the earliest routes to the systemic circulation has been utilised utilising micro-emulsion technologies..

C) Parenteral drug delivery

Micro-emulsion systems intended for parenteral application have to be formulated using nontoxic and biocompatible ingredients. The oil in water micro-emulsion systems would be suitable to improve the solubility of poorly water soluble drug molecules whereas water in oil micro-emulsion systems would be best suited for optimizing the delivery of hydrophilic drug molecules that are susceptible to the harsh gastrointestinal condition.

d) Ocular drug delivery

Aqueous solutions account for around 90% of the available ophthalmic formulations, mainly due to their simplicity and convenience However, extensive loss caused by rapid precorneal drainage and high tear turnover are among the main drawbacks associated with topical ocular drug delivery.

Advantages:[7]

• To solubilize hydrophobic or oil-soluble medications

• To improve drug absorption through

• To improve drug absorption through topical administration

• To hide the unpleasant taste and odour of drugs

• To improve the palatability of nutritional oils

Disadvantages of Micro-emulsion [8]

1. For pharmaceutical uses, the surfactant must be nontoxic.

2. High-melting-point compounds have a limited solubilizing capacity.

3. The use of a high concentration of surfactant and co-surfactant is required for the micro droplets to be stabilised.

4. Environmental factors such as temperature and pH affect the stability of microemulsions.

C. Structure of Micro Emulsion [9]

Micro emulsions, also known as Micellar emulsions, are dynamic systems in which the interface fluctuates constantly and spontaneously. 7 Oil in water (o/w), water in oil (w/o), and bi-continuous micro emulsions

are the structural divisions. Water droplets are dispersed in the continuous oil phase in w/o micro emulsions, whereas oil droplets are scattered in the continuous aqueous phase in o/w micro emulsions. Bi-continuous micro emulsions can form in systems with equivalent proportions of water and oil. 8 Depending on the quantities of the components, the mixture of oil, water, and surfactants can produce a variety of structures and phases.

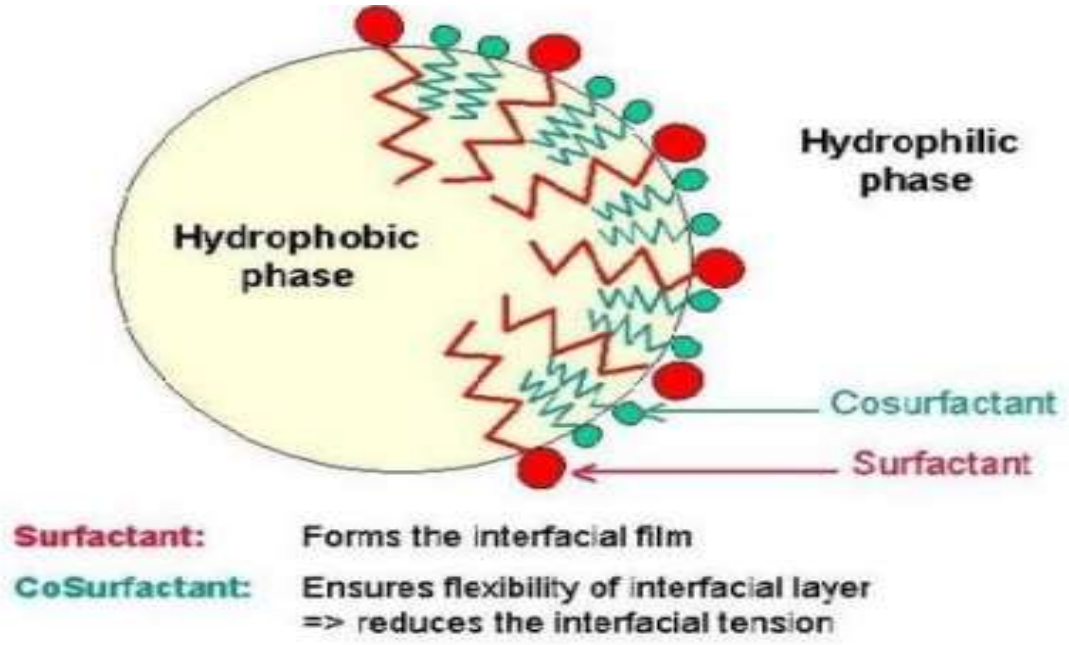

Figure 1: Structure of Microemulsion

D. Factor affecting the formulation of microemulsion

The packing ratio, the chain length, nature of cosurfactant, the property of oil phase, surfactant, type and temperature are responsive for the preparation of water or oil swollen microemulsion.

Packing ratio

Through its impact on film curvature and molecular packing, the surfactant Hydrophilic Lipophilic Balance (HLB) supports to determine the type of microemulsion. For associations of surfactant governing to microemulsion preparation in packing ratio terms, Mitchell and Ninham (1977) and Israclachvili (1976) elucidated and analyses the film curvature and titled it as a critical packing parameter. CPP = v/a * l Critical Packing Parameter

Property of surfactant

Hydrophilic and lipophilic groups are the two groups of surfactants. Cetyl ethyl ammonium bromide is a single chain hydrophilic surfactant which completely dissociates in dilute solution and has an affinity to form oil in water (o/w) microemulsion. When a high concentration of surfactant is employed or when the surfactant is in the existence of salt, the polar group's dissociation degree becomes lesser and the resultant may be w/o type system. (Singh et al., 2014; Chang et al., 2019).[10][11]

Property of oil phase

Curvature is influenced by the oil phase owing to its penetration capacity and swelling of the tail group of the surfactant monolayer, greater negative curvature is due to tail swelling results in w/o microemulsion**.** (Singh et al., 2014; Du et al., 2016)[10][12]

Temperature

In order to determine the size of the active head group for nonionic surfactants, the temperature is tremendously significant. Oil in water structure is formed at lesser temperatures as its nature is hydrophilic. Water in oil structure is formed at greater temperatures as its nature is lipophilic. A Bicontinuous system is formed at an intermediary temperature due to the coexistence of microemulsion with excess oil and water phases. (Singh et al., 2014; Chai et al., 2017).[10][13]

E. Preparation methods

1. Phase titration method

   Micro emulsion was made by dispersing the desired amount of medicine in the suitable amount of oil required for drug solubilization. The liquid was homogenised, then a small amount of surfactant: cosurfactant mixtures was carefully weighed and stirred into it. The mixes were completely mixed with a magnetic stirrer, and dropwise double distilled water was added to it with continuous stirring for about 10 minutes, with the rate of stirring optimised according to particle size requirements.

2. The phase inversion temperature method

(PIT) is a technique for determining the temperature of a phase inversion.

When non-ionic surfactants are employed to change the spontaneous curvature of the surfactant, phase inversion of micro emulsions involves converting an O/W system to a W/O system by adding excess of the dispersed phase or by raising the temperature Characterization of micro emulsion

F. Microscopy

Although the optical isotropy of the microemulsion system is confirmed by polarizing microscopy, for studying microemulsions, conventional optical microscopy cannot be employed because of the smaller size of the droplet which is typically lesser than 150 nm diameter. However, for the characterization and study of microemulsions freezefracture techniques in combination with TEM (transmission electron microscopy) have been applied successfully. The microemulsion structures are sensitive to temperature. Other complications are (1) microemulsion high vapour pressure, which is not compatible with microscopy low pressures (2) chemical reaction induced by electrons, thus, alteration in the structure of microemulsion and (3) lack of contrast between the environment and microemulsion structure. The techniques of freeze fracture-TEM and Cryo-TEM which have developed from these improvements, permit direct microemulsion visualization with rarer artifactual result problems. (Agrawal and Agrawal, 2012)[14]

G. Conductivity and viscosity

Determination of phase inversion and nature of microemulsion is detected by using conductivity and by classical rheological approaches. Determination of viscosity also delivers valuable evidence on exactly how the drug release is influenced by colloidal systems. The possible structures existing are, for example, worm-like or rod-like reverse micelles with multilamellar layers vesicles. Water-continuous systems should have high conductivity values, while oil-continuous microemulsions display no or poor conductivity. Formerly, it has been verified that at definite volume fractions of water (Φp) microemulsions may display phenomena of percolation named the percolation threshold. The behavior of the system will be as an insulator when the water fraction is lower than Φp, however water fraction values somewhat greater than Φp, the operational conductivity sharply increases. (Agrawal and Agrawal, 2012)[14]

H. Dynamic light scattering

It is similarly denoted as PCS (photon correlation spectroscopy), is used for the analysis of the fluctuations due to Brownian motion in droplet scattering intensity. The determination of self correlation gives information on system dynamics. This system permits the measurement of z-average diffusion coefficients. (Agrawal and Agrawal, 2012)[14]

I. Zeta potential measurement

It must be neutral or negative, which specify the structure is stable and droplets of microemulsion have no charge. Zetasizer is used to measure Zeta potential. Since the rate of flocculation is influenced by particle electrical charges, zeta potential is principally valuable for evaluating flocculation.

J. Conclusion

Microemulsions are drug delivery systems that can deliver many medications at the same time. Microemulsions have been shown to protect labile drugs, control drug release, increase drug solubility, boost bioavailability, and reduce patient variability. It has also been shown that preparations suitable for most routes of administration may be formulated. The function of microemulsion in giving unique methods to solve the issues of poor aqueous solubility of highly lipophilic medicinal molecules and deliver high, consistent, and repeatable bioavailability. Drug delivery by microemulsions is a promising field for further investigation with the goal of obtaining controlled release with increased bioavailability and drug targeting to various body locations.

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