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Review Article

MICROEMULSIONS: A NOVEL DRUG CARRIER SYSTEM

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ABSTRACT
Microemulsions are clear, transparent, thermodynamically stable dispersions of oil and water, stabilized by an interfacial film of surfactant frequently in combination with a co-surfactant. Recently, there has been a considerable interest for the microemulsion formulation, for the delivery of hydrophilic as well as lipophilic drug as drug carriers because of its improved drug solubilization capacity, long shelf life, easy of preparation and improvement of bioavailability. In this present review, we discuss about the various advantages of microemulsion in pharmaceuticals, along with its preparation, evaluation and research work carried out on microemulsions.

Key words: microemulsions, advantages of microemulsions, research work on microemulsions.

INTRODUCTION

Microemulsions [1-5] is homogeneous, transparent, thermodynamically stable dispersions of water and oil, stabilized by a surfactant, usually in combination with a cosurfactant and whose diameter is in the range of 10-140 nm. In this type of system, the two liquids tend to separate out in two layers. And to avoid this, a third substance called as an emulsifier is added which is, in general, surface-active agent or surfactant. Surfactant molecules contain both a polar and an apolar group. So they exhibit a very peculiar behavior, first, they tend to adsorb at interface, where they can fulfill their dual affinity with hydrophilic groups located in aqueous phase and hydrophobic groups in oil or air. Second, they reduce the mismatch with solvent through a specific kind of aggregation process known as micellization.

Advantages of Microemulsions:

Microemulsions are potential drug carrier systems [6] for various routes of administration. These are having advantages when compare to the other dosage forms.

a. These are thermodynamically stable and require minimum energy for formation.
b. Ease of manufacturing and scale-up
c. Improved drug solubilization and bioavailability.
d. This system is reckoned advantageous because of its wide applications in colloidal drug delivery systems for the purpose of drug targeting and controlled release.

Factors Affecting the Microemulsion:

The formation of microemulsion will depend on the following factors

a. ***Packing ratio:*** The HLB of surfactant determines the type of microemulsion through its influence on molecular packing and film curvature. The analysis of film curvature for surfactant association's leadings to the formation of microemulsion.
b. ***Property of surfactant, oil phase and temperature:*** The type of microemulsion depends on the nature of surfactant. Surfactant contains hydrophilic head group and lipophilic tail group. The areas of these group, which are a measure of the differential tendency of water to swell head group and oil to swell the tail area are important for specific formulation when estimating the surfactant HLB in a particular system. When a high concentration of the surfactant is used or when the surfactant is in presence of salt, degree of dissociation of polar groups becomes lesser and resulting system may be w/o type. Diluting with water may increase dissociation and leads to an o/w system. Ionic surfactants are strongly influenced by temperature. It mainly causes increased surfactant counter-ion dissociation. The oil component also influences curvature by its ability to penetrate and hence swell the tail group region of the surfactant monolayer. Short chains oils penetrate the lipophilic group region to a great extent and results in increased negative curvature. Temperature is extremely important in determining the effective head group size of nonionic surfactants. At low temperature, they are hydrophilic and form normal o/w system. At higher temperature, they are lipophilic and form w/o systems. At an intermediate temperature, microemulsion coexists with excess water and oil phases and forms bicontinuous structure.
c. ***The chain length, type and nature of cosurfactant:*** Alcohols are widely used as a cosurfactant in microemulsions. Addition of shorter chain cosurfactant gives positive curvature effect as alcohol swells the head region more than tail region so, it becomes more hydrophilic and o/w type is

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Table 1: Research Work carried out on Microemulsions

Drug Name	Route	Purpose/Result
Flurbiprofen[7]	Parenteral	Increased the solubility
Apormorphine HCL[8]	Transdermal	Increased the permeability
Ketoprofen[9]	Transdermal	Enhancement of permeability
Prilocainne-HCL[10]	Transdermal	Increased the solubility
Estradiol[11]	Transdermal	Improvement in solubilization
Aceclofenac[12]	Dermatological	Increased the solubility
Piroxicam[13]	Oral	Increased the solubility
Diclofenac[14]	Transdermal	Permeability enhancement
Dexamethasone[15]	Topical Ocular	Enhanced the Bioavailability
Chloramphenicol[16]	Ocular	Increased the solubility
Ibuprofen[17]	Parenteral	Increased the solubility
Sumatriptan[18]	Intranasal	Enhanced the Bioavailability
Ibuprofen[19]	Topical	Increasing the solubility
Doxorubicin[20]	-	Increasing the Stability
Itraconazole[21]	Parenteral	For better absorption
Timolol[22]	Ophthalmic	For better absorption
Terbinafine[23]	Transdermal	Permeability enhancement
Fenofibrate[24]	Self-Micro emulsifying	Increasing the solubility
Progesterone[25]	Dermal	Increased the chemical Stability

favoured, while longer chain cosurfactant favours w/o type w/o type by alcohol swelling more in chain region than head region.

Preparation of Microemulsions:

Microemulsions are thermodynamically stable, so they can prepared simply by blending oil, water, surfactant and cosurfactant with mild agitation or mild heat. For preparing o/w microemulsion, w/o emulsion containing a lipophilic surface-active agent may be used as a base. In this process, hydrophilic surface-active agent is added by stirring which initially forms cubic structure but on further addition of hydrophilic surface-active agent forms microemulsion.

Evaluation of Microemulsions:

The microemulsions are evaluated by the following techniques. They are

Phase behavior studies: visual observations, phase contrast microscopy and freeze fracture transmission electron microscopy can be used to differentiate microemulsions from liquid crystals and coarse emulsions. Clear isotropic one-phase systems are identified as microemulsions whereas opaque systems showing bifringence when viewed by cross polarized light microscopy may be taken as liquid crystalline system.

Rheology: change in the rheological characteristics help in determining the microemulsion region and its separation from other related structures like liquid crystals. Bicontinuous microemulsion are dynamic structures with continuous fluctuations occurring between the Bicontinuous structure, swollen reverse micelle, and swollen micelles.

Scattering Techniques: Scattering techniques such as small angle neutron scattering, small angle X-ray scattering and light scattering have found applications in studies of microemulsion structure, particularly in case of dilute monodisperese spheres, when polydisperse and/or concentrated systems such as those frequently seen in microemulsions.

Research Work on Microemulsions:

During the last one decay much research work has been done on microemulsions for various routes of drug administration. Due to their unique properties namely, ultraflow interfacial tension, large interfacial area, thermodynamic stability and the ability to solubilize otherwise immiscible liquids. Research work on microemulsions is summarized in Table 1:

Conclusion:

Microemulsions are optically isotropic and thermodynamically stable liquid solutions of oil, water and amphiphile. Microemulsions are readily distinguished from normal emulsions by their transparency, low viscosity and more fundamentally their thermodynamic stability. Drug delivery through microemulsions is a promising area for continued research with the aim of achieving controlled release with enhanced bioavailability and for drug targeting to various sites in the body.

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