Review article

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A MINI REVIEW ON NANOEMULSION

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ABSTRACT

Nanoemulsion are clear, thermodynamically stable dispersion system composed of two immiscible oil and aqueous phase, stabilized by an interfacial film of surfactant and cosurfactant molecules. Nanoemulsion droplets size range between 20-500 nm. Nanoemulsions are widely used as an advanced mode of in-vivo drug delivery system for controlled or sustained release of active drug ingredients. Drug-loaded nanoemulsions have been widely employed to improve solubility and bioavailability of lipophilic as well as hydrophilic drugs. Nanoemulsions find its applications in diverse areas, particularly in pharmaceutical and cosmetic fields. This review article briefly explain about the classification, method of preparation, characterization parameters of nanoemulsions, and its advantages on novel drug delivery over other dosage forms.

Keywords: Nanoemulsion, Drug Delivery System, Formulation, Characterization

INTRODUCTION

Nanoemulsion, also known as submicron emulsions, miniemulsion, and ultrafine emulsions [5], are transparent colloidal dispersion system comprising of two immiscible phases, an organic phase (oil) and aqueous phase (water), stabilized by an interfacial film of surfactant and cosurfactant molecules to give droplets size ranging approximately 20-500nm. [4] Nanoemulsion are thermodynamically and kinetically stable isotropic system which used in novel drug delivery system for controlled or sustained release of therapeutic agents. [1]

Nanoemulsions offers several advantages over other dosage forms, these include increased absorption rate and bioavailability of drugs, improved solubilisation of lipid soluble drugs, non-toxic, non-irritant, protection of drugs against oxidation and hydrolysis in O/W nanoemulsions, effective in-vivo delivery of therapeutic drugs while reducing total dose required and adverse effects, masking of unpalatable taste, ability to prepare it in various formulations, i.e, creams, foams, liquids and sprays. [1] [2]

CLASSIFICATION OF NANOEMULSIONS

Nanoemulsions are generally classified into three categories, which are water-in-oil type (W/O), oil-in-water type (O/W), and bicontinuous. W/O type nanoemulsions comprising of continuous oily phase where water droplets dispersed in it, whereas in O/W type, oil is dispersed in water which act as continuous phase.

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Bicontinuous nanoemulsions composed of inter-dispersion of oil and water within the system. [1][3][7].

Formulation of nanoemulsions

The main components required for formulation of nanoemulsions are oil, water, surfactant and cosurfactant, at which active drug ingredients can be incorporated in it. [1][2][3] A variety of non-ionic, cationic, anionic and zwitterionic surfactants [8] are often used for stabilization of nanoemulsions at which they reduce interfacial tension between immiscible organic and aqueous phases. [5]

Nanoemulsions are generally prepared in a two-step process, where a macroemulsion is prepared firstly, followed by conversion into nanoemulsion. [6] Depending on the selected compositions and desirable particle size of nanoemulsions, nanoemulsions are generally formulated by high-energy and low-energy emulsification methods.

High-energy methods include, ultrasonic emulsification, high pressure homogenization, microfluidization, and Brute force method, whereas low-energy methods include, phase inversion technique/persuasion method, emulsion inversion point and spontaneous emulsification. [1][2][6][7]

Characterization of nanoemulsions

Droplet size:

The droplets size is critical to influence the overall properties of nanoemulsion. Morphology and particle size distribution of droplets can be studied by using light scattering technique [4] or transmission electron microscopy (TEM).[3] The uniformity of droplet size in nanoemulsion can be indicated by polydispersity index. [1][2]

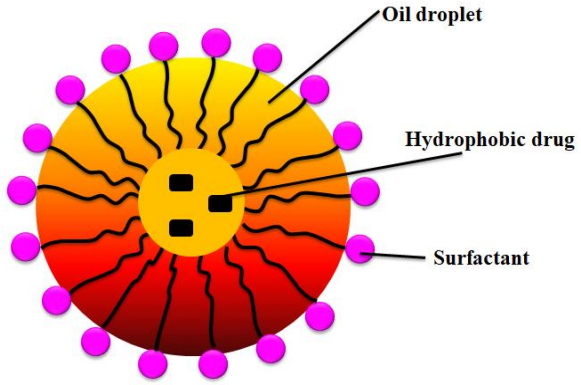

Figure 1 : O/W Nanoemulsions

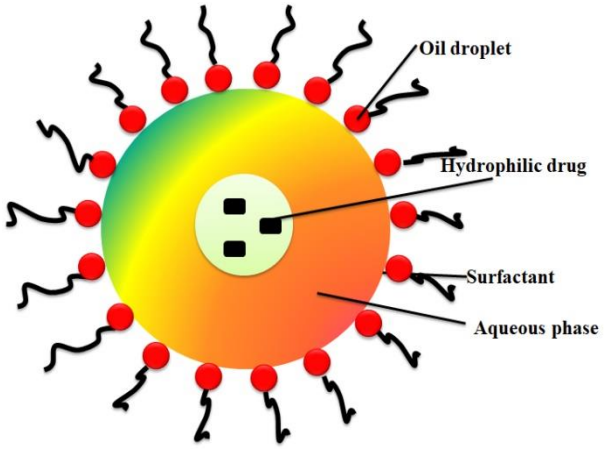

Figure 2: W/O Nanoemulsions

Viscosity:

Brookfield viscometer [4] is the most preferable instrument used for measurement of viscosity of nanoemulsions. Determination of viscosity can be used for estimating the type of emulsions. Indeed, W/O type shows high viscosity of the system, whereas O/W type shows lower viscosity. [2]

Refractive index:

Refractive index measures the bending of light as it propagates from one medium to another. It is measured using Abbes type refractometer. [3]

Thermodynamic Stability Studies:

Physical and chemical stability of drug loaded nanoemulsions are assessed at various steps under influence of several environmental factors, such as temperature, moisture and light, as per International Conference of Harmonization guidelines. Firstly, heating cooling cycle. Nanoemulsions are stored under temperature ranging between 4°C and 45°C for not less than 48 hours. The formulations which are stable at particular temperature is then selected and subjected to centrifugation at 5000 rpm for 30 minutes. Any signs of phase separation and cracking of emulsions are observed. Thirdly, the formulations which does not any sign of instability in second step are exposed to three freeze thaw cycles, at temperature ranging between -21°C and 25°C for a period of 3 months. The particular nanoemulsion formulation that passes all three tests are considered to be thermodynamically stable. [2][3]

pH:

pH meter is used for determining the pH of nanoemulsions. [1]

Surface charge:

Surface charge of droplets in nanoemulsions is indicated by measurement of Zeta potential. Zeta potential is used for predicting dispersion stability by incorporating Malvern Zetasizer instruments. [2]

Percentage transmittance studies

A UV-Visible Spectrophotometer [1] is used for determination of percentage transmittance of nanoemulsion at a particular wavelength of radiations. Nanoemulsion with percent transmittance close to 100 % is considered to be transparent and clear in nature. [2]

Drug content:

Reverse-phased High Performance Liquid Chromatography (RP-HPLC) is generally used for assay of drug contents entrapped in nanoemulsions against standard solution of drugs. [3]

Electrical Conductivity:

Conductivity meter is the instrument used for measurement of electrical conductivity which particularly important for differentiation of types of nanoemulsions. A pair of electrodes are dipped into an emulsion and connected in a series to a light bulb. [1] As water is electrically conductive, thus, the light bulb glow in O/W nanoemulsions at which water acts as continuous phase and allows for passage of currents between electrodes. However, light bulb does not glow in W/O type nanoemulsions. [2]

Dye test:

On addition of water soluble dyes, it is soluble in continuous aqueous phase on O/W nanoemulsion and become uniformly coloured. However, for W/O nanoemulsion, only dispersed phase will take up the dyes and it is not evenly coloured. [1,2]

Fluorescence test:

On exposure to UV light, W/O nanoemulsion exhibit fluorescence in its entire dispersion, whereas O/W nanoemulsion fluoresce as spotty patterns [1]

CONCLUSION

Nanoemulsions have been widely used for the past decades due to its submicron-sized droplets, great surface area, robust stability, optically clear appearance and tunable rheology. [6] Nanoemulsions find its diverse applications in food, cosmetic, and pharmaceutical industries. Besides, it is also a newer approach for controlled and targeted drug delivery system.

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