International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 05 Issue 09 September 2022
DOI: 10.47191/ijcsrr/V5-i9-41, Impact Factor: 5.995
IJCSRR @ 2022
www.ijcsrr.org

A Review on Novel Drug Delivery System Nanoemulsion

Sakib Shikalgar[1], Miss. Ashvini Khule[2], Mr. Avinash Godse[3]
[1] M pharm, Late suman Dhekane Dept. of Pharmacy, Satara
[2,3] Late suman Dhekane Dept of Pharmacy, Satara

ABSTRACT: various researcher are innovate a replacement therapy regarding improvement of drug action. Improve drugs absorption, distribution also we improve its efficacy. Amongst that a replacement innovative technology are develops. A nanoemulsion is technique to enhance the solubility, bioavability, pharmacokinetic and pharmacodinemics of medicine .in this review article us familiar about the novel technique nanoemulsion and its preparation methods, charactorization of nanoemulsion. Nanoemulsion has been identified as a promising delivery system for various drugs including biopharmaceuticals. Nanoemulsion may be a heterogeneous system composed of one immiscible liquid dispersed as droplets within another liquid. The droplets size of nano emulsion is between 20 to 500 nm. Diameter and surface properties of droplets of nanoemulsion plays a crucial role in the biological behavior of the formulation. Small droplet sizes cause transparent emulsions so that product appearance is not altered by the addition of an oil phase during this paper various aspects of nanoemulsion have been discussed including advantages, disadvantages and methods of preparation. Furthermore new approaches of stability of formulation, effect of types and concentration of surfactant, process variables and method also are discussed to improve the stability of nanoemulsion formulation.

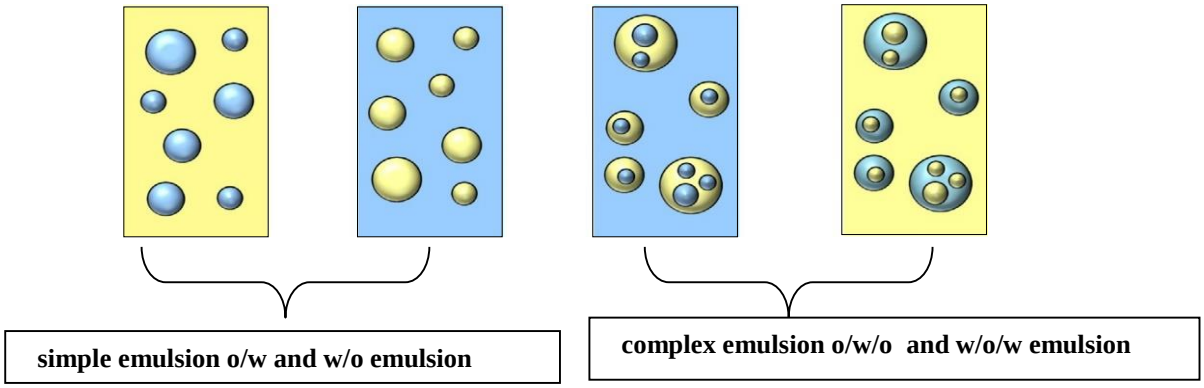
KEYWORDS: Nanoemulsion, types, solubility, efficacy.

INTRODUCTION

An novel system of drug delivery may fulfill with aim of reducing toxicity and increasing efficacy. With the progress in time and advances in science and technology, dosage forms have evolved from simple mixtures and pills, to highly sophisticated systems, which are referred to as novel drug delivery systems. One among the examples of novel drug delivery system is nanoemulsions [1]. The nanoemulsion are defined as thermodynamically stable, isotropically clear dispersion of two immiscible liquids like oil and water, stabilized by an interfacial film of surfactant molecule [2]. Nanoemulsion is emulsion with uniform and very small droplet size in the range of 20-200 nm [3]. Nanoemulsions don't form spontaneously; to rupture larger droplets into smaller ones, external shear must be applied. As we compared to micro emulsion phases, relatively little is understood about creating and controlling nano-emulsions. Nanoparticles have a number of physicochemical and physiological characteristics that make them particularly suitable materials for these applications, which are related to their small particle size and high surface area. [4]

STRUCTURE OF NANOEMULSIONS

Nanoemulsions consist of a dispersion of small droplets of one immiscible liq- uid in another immiscible liquid [5].The two immiscible liquids most widely used in commercial applications are oil and water, so for the purpose nanoemulsions are in form of oil-in-water (O/W) or the water-in-oil (W/O) type (fig).



International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 05 Issue 09 September 2022
DOI: 10.47191/ijcsrr/V5-i9-41, Impact Factor: 5.995
IJCSRR @ 2022
www.ijcsrr.org

O/ W nanoemulsions contains of small oil particles drops dispersed in an aqueous medium, whereas W/ O nanoemul- sions correspond of small water droplets dispersed in an oleaginous medium(6). O/ W nanoemulsions are far more generally utilized than W/ O ones, and thus, they're going to be the major focus of this book. The droplets in O/ W nanoemulsions are generally carpeted by a hydrophilic emulsifier, whereas those in W/ O nanoemulsions are covered by a lipophilic emulsifier. The character of the emulsifier present at the oil- water interface plays a critical role in determining the overall functional attributes of nanoemulsions and should be precisely selected for each specific operation.

O/ W nanoemulsions are frequently used as templates to make other types of struc- tured nanoparticle dispersion. Solid lipid nanoparticles(SLNs) and nanostructured lipid carriers(NLCs) correspond of fully or partly crystalline lipid particles dispersed in an aqueous medium, respectively Typically, an O/ W nanoemulsion is initially formed by homogenizing a high- melting lipid and an aqueous phase containing a hydrophilic surfactant at a temperature above the freezing point of the lipid. The system is additionally cooled below the lipid phase melting point, which ends up in the crystallization of the oil droplets. The solidified lipid introduce SLNs and NLCs retards molecular diffusion processes, which are useful for inhibiting the chemical degradation or controlling the discharge of encapsulated substances. The physical state of the lipid droplets can also alter the density and refractive index, which may change the creaming stability and optical properties of nanoemulsions. Other sorts of structures can also be produced using nanoemulsions as building blocks, including multiple emulsions of the water-in-oil-in-water (W/O/W) or oil-in-water-in-oil (O/W/O) type .These systems are usu- ally produced employing a two-step process For example, a W/O/W emulsion is produced by initially forming a W/O nanoemulsion by homogenizing a water phase with an oil phase containing a lipophilic surfactant together, and then, this nanoemulsion is homogenized with a water phase con- taining a hydrophilic surfactant. Multiple emulsions have advantages surely applications, like protecting a hydrophilic substance from the external aque- ous phase, controlling the discharge of a hydrophilic substance, reducing the off-flavor of a hydrophilic substance (such as bitterness or astringency), or reducing the general fat content of the system .

Nanoemulsions also can be used as building blocks for other types of struc- tures, like filled hydrogels . during this case, an O/W nanoemulsion is mixed with a biopolymer solution that's capable of forming a hydrogel, and then, a two-step process is employed to form the filled hydrogels, particle formation and particle gelation. Initially, a particle is made that contains small lipid droplets trapped inside a larger biopolymer-rich water droplet, then the system conditions are changed to cross-link the biopolymers within the water droplet.Filled hydrogels are often designed to encapsulate, protect, and release bio- active components by altering their dimensions, internal composition, or struc- ture. This will be achieved by altering the fabrication method used and the type and concentration of biopolymer and cross-linking agents used. additionally, the properties of the lipid droplets trapped inside the hydrogels also can be con- trolled, like their size, concentration, composition, or charge.

Nanoemulsions also can be used to create other types of structures such as colloidosomes or microclusters . A colloidosome consists of an outsized central particle with smaller particles adsorbed to its surface, whereas a micro- cluster consists of variety of smaller particles held together by attractive forces. These sorts of structures may be created from nanoemulsions in order to change the rheological, optical, or stability properties of materials or for con- trolled release applications.

ADVANTAGES OF NANOEMULSION

- It gives site specific delivery of medicine
- Nanoemulsion has capacity to dissolve large quantities of hydrophobics
- Ability to guard drugs from degradation with long term stability which leads to making an ideal drug delivery system [6]
- This could also be used as substitute for the vesicles and liposomes
- It is non-irritant and non-toxic
- This are wont to improves the bioavailability of drug
- It provide greater absorption because have small-sized droplets having greater area
- It is feasible to formulate it in variety of formulations i.e., as creams, liquids, foams, and sprays
- This is additionally used in taste masking
- In cell culture technology it provides better uptake of oil-soluble supplements [7]

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 05 Issue 09 September 2022
DOI: 10.47191/ijcsrr/V5-i9-41, Impact Factor: 5.995
IJCSRR @ 2022
www.ijcsrr.org

DISADVANTAGES OF NANOEMULSIONS

- It requires large concentration of surfactant and cosurfactant for stabilizing the nanodroplets
- It generally shows a limited solubilizing capacity for high-melting substances
- There is lacuna for understanding the interfacial chemistry which is involved in production of nanoemulsions
- For use in pharmaceutical applications the character of surfactant must be nontoxic
- It requires the utilization of high concentrations of emulsifiers [8,9]

MECHANISM OF NANO EMULSION SYSTEM

The entropy was changes which favor the dispersion is bigger than the energy that required to increase the surface of dispersion due to this free energy of conventional emulsion is direct function of energy is required to create new surface between oil and water phase and the addition of emulsifying agent to reduce the interfacial tension and because of this emulsion is stabilized [10-13].

Application of nanoemulsion

Nanoemulsion has become a really attractive formulation for the delivery of pharmaceuticals. Nanoemulsion also shows an honest advantage in the field of cosmetics. The attraction of nanoemulsion formulation in pharmaceuticals and cosmet- ics is thanks to following reasons.

Nanoemulsion never shows the creaming and sedimentation quite problems thanks to its very small droplet size. These problems are quite common with conven- tional emulsion and even microemulsion. Basically both problems are associated with the influence of gravitational force over the droplet of emulsion. But just in case of nanoemulsion the droplet size is very small which minimized the working of gravitational forceover the droplets and posses creaming and sedimenta- tion of emulsion.

• Again small droplet size of nanoemulsion prevents the coalescence of droplets.In the coalescence process droplets come together and form a large droplet with increased size which is responsible for the instability of emulsion. But the small droplet size of nanoemulsion prevent the coalescence among them and prevent the deformation and than surface fluctuation.

• Dispersibility of nanoemulsion is extremely high as com- pared to microemulsion because small droplet size pre- vents the flocculation of droplets and this process makes the system dispersed without separation.

• Nanoemulsion formulation provides a rapid penetration of active ingredients through skin thanks to the large sur- face area of droplets. Even sometimes it's found that nanoemulsion penetrate easily through rough skin. This property of nanoemulsion minimizes the extra utilization of special penetration enhancer which is re- sponsible for incompatibility of formulation.

• Nanoemulsion formulation required low amount of surfactant compared to microemulsion. for instance about 20- 25 % surfactant is required for the prepara- tion of microemulsion but 5-10 % surfactant is suffi- cient in case of nanoemulsion. Again with the assistance of nanoemulsion surfactant utilization can be minimized.

• Nanoemulsion features a transparent and fluidy property which improves the formulation patient compliance and safe for administration due to the absence of any thick- ening agent and colloidal particles.

• It is additionally reported that nanoemulsion may be used for the target delivery of active ingredient especially in cancer therapy.

• Nanoemulsion formulation may become the stable al- ternate for the liposomes and vesicle sort of delivery systems.

• Nanoemulsion formulation are often administered by the various routes of body. There are various reported methods which support the administration of nanoe- mulsion formulation through paranteral , oral , topical , nasal and ocular route.

• These formulations could also be used to increase the bioavailability of poor water soluble drug by develop- ing oil in water type of nanoemulsion [14-28].

PREPARATION METHODS OF NANOEMULSION

Several methods are suggested for the preparation of nanoemulsion. the essential objectives of the nanoemulsion preparation to realize the droplet size range of 100-600 nm and another is to provide the stability condition. Formation of nanoemulsion system required a high amount of energy. This energy are often provided either by mechanical equip- ment or the chemical potential inherent within the compo- nent [29]. Here some methods are discussed which are freely used for the nanoemulsion preparation.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 05 Issue 09 September 2022
DOI: 10.47191/ijcsrr/V5-i9-41, Impact Factor: 5.995
IJCSRR @ 2022
www.ijcsrr.org

1. Phase inversion method

In this method fine dispersion is obtained by chemical en- ergy resulting of phase transitions taking place through emulsification path. The adequate phase transitions are produced by varying the composition at constant tempera- ture or by varying the temperature at constant composi- tion, phase inversion temperature (PIT) method was intro- duced by Shinoda et al. supported the changes of solubility of polyoxyethylene- type surfactant with temperature. This surfactant becomes lipophilic with increase in temperature because of dehydration of polymer chain. But at low tempera- ture, the surfactant monolayer features an outsized positive sponta- neous curvature forming oil-swollen micellar solution phase [30].

2. Sonication method

Sonication method is another best because of prepare nanoe- mulsion. during this method the droplet size of conventional emulsion or maybe microemulsion are reduced with the help of sonication mechanism. This method isn't suitable for giant batches only small batches of nanoemulsion can be prepared by this method [31].

3. High homogenizer

This method is performed by applying a high over the system having oil phase, aqueous phase and sur- factant or co-surfactant. The pressure is applied with the help of a special equipment know as homogenizer. There are some problems which are associated with homogenizer such as poor productivity, component deterioration because of difficult mass production and generation of much heat. With this method only oil in water (o/w) liquid nanoemulsion of but 20% oil phase are often prepared and cream nanoemulsion of high viscosity or hardness with a mean droplet diameter lower than 200 nm cannot be prepared [32].

CHARACTERIZATION OF NANOPARTICLES

Nano-emulsions aren't thermodynamically stable, and, due to that, their characteristics will depend upon prepara- tion method. Here some parameters are discussed which should be analyzed at the time of preparation of nanoemul- sion [33].

(i) Phase behaviour study: This study may be a characterization and optimization of ingredients (surfactant, oil phase and aqueous phase). Generally the study is important in case of nanoemulsion formulation prepared by phase inversion temperature method and self emulsification method in order to determine the phase of nanoemulsion and dispersibility. Study is completed by placing the different ingredients of nanoemulsion by varying the concentration in glass am- pules and thoroughly homogenized at a certain temperature for a time until equilibrium. Anisotropic phase are often iden- tified by polarized light.

(ii) Particle Size Analysis: Formulated nanoemulsion should be analyzed for his or her hydrodynamic particle size and particle size distribution. Generally just in case of nanoemulsion dynamic light scattering (DLS) method are used for the measurement of particles and further particle size distribu- tion.

(iii) Surface charge measurement: Surface zeta potential of nanoemulsion droplets should be measured with the assistance of mini electrode to predict the surface properties of nanoemulsion.

(iv) Transmission microscopy (TEM): This method is used to observe the morphology in the nanoemul- sion.

(v) Drug contain: This method is employed to determine the amount of drug contained in the formulation. Various methods (especially Western Blot method) are utilized in this order.

(vi) Viscosity: Viscosity should be measured to make sure the better delivery of the formulation.

NANOEMULSION INSTABILITY.

The instability of nanoemulsion is thanks to some main factors including creaming [34] flocculation [35, 36], coalescence[37] and Ostwald ripening [38]. Among them ostwald rip- ening is that the main mechanism of nanoemulsion instability because rest of the problem are minimized by the small size of nanoemulsion and use of nonionic type of surfactant. Creaming of nanoemulsion is prevented by the faster diffu- sion rate of smaller droplets. Vanderwall force is responsi- ble for the attraction of droplets and results in the floccula- tion of emulsion. But just in case of nanoemulsion nonionic surfactant, it doesn't create any kind of attractive force, hence no flocculation occurs. The droplet size of nanoemul- sion also prevent the flocculation because these small drop- lets show high curvature and laplace pressure opposes the deformation of huge droplets [39].Coalescence of droplets of nanoemulsion are often prevented by a thick multilamellar surfactant film adsorbed over the interface of droplets [40].

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 05 Issue 09 September 2022
DOI: 10.47191/ijcsrr/V5-i9-41, Impact Factor: 5.995
IJCSRR @ 2022
www.ijcsrr.org

REFERENCESS

1. Chime SA, Kenechukwu FC, Attama AA (2014) Nanoemulsions-advances in formulation, characterization and applications in drug delivery. Intecchapter 3:
2. 77-126.
3. Mishra RK, Soni GC, Mishra R (2014) Nanoemulsion: a novel drug delivery tool. IJPRR 3: 32-43.
4. Chellapa P, Mohamed AT, Keleb EI, Elmahgoubi A, Eid AM, et al. (2015) Nanoemulsion and nanoemulgel as a topical formulation. IOSR J Pharm 5: 43-47.
5. Jafari, S.M., McClements, D.J., 2017. Nanotechnology approaches for increasing nutrient bioavail-ability. In: Advances in Food and Nutrition Research. Academic Press, San Diego, CA.
6. McClements, D.J., Rao, J., 2011. Food-grade nanoemulsions: formulation, fabrication, properties,performance, biological fate, and potential toxicity. Crit. Rev. Food Sci. Nutr. 51, 285–330.
7. Jafari, S.M., 2017. An overview of nano-encapsulation techniques and their classification. In: Jafari, S.M., Jafari, S.M. (Eds.), Nano-encapsulation Technologies for the Food and Nutra-ceutical Industries. Elsevier, San Diego, CA.
8. Jaiswal M, Dudhe R, Sharma PK (2015) Nanoemulsion: an advanced mode of drug delivery system. 3 Biotech 5: 123-7.
9. Lovelyn C, Attama AA (2011) Current state of nanoemulsions in drug delivery. JBNB 2: 626-39.
10. Devarajan V, Ravichandran V (2011) Nanoemulsions: as modified drug delivery tool. Pharmacie Globale (IJCP) 2: 1-6.
11. Mahajan HS, Savale SK (2016) Nanoemulsion: a versatile mode of drug delivery system. IJNDD 8: 123-32.
12. Kumar A, Sharma S, Kamble R (2010) Self emulsifying drug delivery system (sedds): future aspects. Int J Pharm Pharm Sci 2: 7-13.
13. Nazzal S, Smalyukh II, Lavrentovich OD, Khan MAN (2002) Preparation and in vitro characterization of a eutectic based semisolid self-nanoemulsified drug delivery system (SNEDDS) of ubiquinone: mechanism and progress of emulsion formation. Int J Pharm 235: 247-65.
14. Gupta P, Sharma PK, Kumar N, Pawar Y, Gupta J (2014) Self nano emulsifying drug delivery system: a strategy to improve oral bioavailability. WJPPS 3: 506-12.
15. Tharwat F, Colloids in cosmetics and personal care, 2003;(4): 36-39.
16. Nakajima, Hideo O, Miyuki T, Emulsified composition, US patent 5,098,606, 1992.
17. European patent 0363928 Bl, 1994.
18. Ping L, Ghosh A, Wagner R.F., Krill S, Joshi Y.M and Serajuddin A.T.M., Effect of combined use of nonionic surfactant on formation of oil-in-water microemulsions, Int. J. Pharm, 2005; (288), 27–34.
19. Mbela TKM, Deharo E, Haemers A, Ludwig A, Submi- cron oil-in-water emulsion formulations for mefloquine and halofantrine : Effect of electric-charge inducers on antimalarial activity in mice, J Pharm Pharmacol, 1998; (50), 1221-1225.
20. Bhalani VT, Satishchandra SP, Pharmaceutical compo- sition for cyclosporines, US Patent 5858401 A. 1999.
21. Ghosh PK. and Murthy RSR, Microemulsions: A poten-tial drug delivery system, Curr Drug Deliv, 2006; (3): 167–180.
22. Calvo P, Lopez R, Vila-Jato JL, Alonso MJ, Evaluation of cationic polymer-coated nanocapsules as ocular drug carriers, Colloid polym Sci, 1997; (275): 46-53.
23. Restel S, Cauwet-Martin D, Eur patent appl EP 842652 Al. 1998.
24. Schwartz JS, Weisspapir MR, Friedman DI, Enhanced transdermal delivery of diazepam by submicron emul- sion creams, Pharm Res, 1995; (12): 687-692.
25. Ko KT, Needham TE, Zia H, Emulsion formulations of testosterone for nasal administration, Journal of micro-encapsulation, 1998; (15): 197-205.
26. Sznitowska M, Zurowaska-Pryczkowska K, Janiki S, Jarvinen T, Miotic effect and irritation potential of pilo- carpine prodrug incorporated into a submicron emulsionvehicle, Int J Pharm, 1999; (184): 115-120.
27. Shinoda K. Lindman B. Organized surfactant systems: microemulsions, Langmuir 3 (1987): p. 135–179.
28. Wagner JG, Gerard ES, Kaiser DG, The effect of the dosage form on serum levels of indoxole, Clin Pharma- col Ther, 1966; (7): 610-619.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 05 Issue 09 September 2022
DOI: 10.47191/ijcsrr/V5-i9-41, Impact Factor: 5.995
IJCSRR @ 2022
www.ijcsrr.org

29. Kim CK, Cho YJ. Gao ZG, Preparation and evaluationof biphenyl dimethyl dicarboxylate microemulsions for oral delivery, J. Control. Release, 2001; (70): 149–155.
30. Sheikh S, Faiyaz S, Sushma T, Farhan J.A, Develop- ment and bioavilability assessment of ramipril nanoe- mulsion formulation, Eur. J. Phar. Bio, 2007; (66): 227- 243.
31. Shinoda K, Saito H, The effect of temperature on the phase equilibria and the type of dispersion of the ternarysystem composed of water, Cyclohexane and nonionic surfactant, J. Colloid Interface Sci, 1968; (26): 70-74.
32. Walstra P. Emulsion stability, in: P. Becher (Ed.). Ency-clopedia of emulsion technology. Marcel Dekke. New York. 1996; P.1-62.
33. Floury J, Desrumaux. Axelos MAV, Legrand J, Effectof high pressure homogenisation on methylcellulose as food emulsifier, J. Food. Engg, 2003; (58): 227-238.
34. Morales D, Gutie´rrez JM, Garcı´a-Celma MJ, Solans YC, A study of the relation between bicontinuous mi- croemulsion and O/W nanoemulsion formulation, Langmuir 2003; (19): 7196-7200
35. Stokes GG. On the effect of the internal frictionof fluid on the motion of pendulums, Philos Mag, 1851, 1:337- 339.
36. Verwey EJW, Overbeek JThG. Theory of the stability oflyophobic colloids. Amsterdam: Elsevier, 1948.
37. Petsev DN, Den kov ND, Kralchevsky P, Flocculationof Deformable Emulsion Droplets: I. Droplet Shape and Line Tension Effects, J colloid Interface Sci, 1995; (176): 201-213.
38. Kabalnov A, Wennerstrom H, Langmuir, Lubrication in aqueous solutions using cationic surfactants: a study of static and dynamic forces,1996; (12): 276-292.
39. Lifshitz IM, Slezov VV. J, The kinetics of precipitation from supersaturated solid solutions, Phys Chem Solids, 1961; 19-35.
40. Wagner C. Elektrochem. 1961; (65), 581.
41. Batchelor GK, Brownian diffusion of particles with hy- drodynamic interaction, J Fluid Mech, 1976; 74:1.

Cite this Article: Sakib Shikalgar, Miss. Ashvini Khule, Mr. Avinash Godse (2022). A Review on Novel Drug Delivery System Nanoemulsion. International Journal of Current Science Research and Review, 5(9), 3616-3621