Self-Emulsifying Drug Delivery System: A Review

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Abstract- *Self-emulsifying drug delivery systems (SEDDS) are a tried-and-true technique for making poorly soluble compounds more soluble and bioavailable. Oils, surfactants, and sometimes cosolvents make up SEDDS and isotropic mixes. It may be a viable strategy for lipophilic medicines with dissolution rate-limited absorption if these formulations and procedures can create microemulsions or fine oil-in- water (o/w) emulsions following modest stirring and dilution by water phase along the GI tract. An overview of the significant advancements made by SEDDS, as well as its limitations, kinds, manufacturing, characterisation, and biopharmaceutical aspects, are included in this review. The evaluation of SEDDS and its uses are also covered, with an emphasis on the improvements made to the dosage form and solid self-emulsifying delivery mechanism of SEDDS. SEDDS may be researched for the development of a formulation with sustained drug release by incorporating a suitable polymer into the formulation. The development of this technology may result in a novel use for the delivery of medicines. SEDDS has proven to be quite effective at boosting the oral bioavailability of lipophilic products. SEDDS is one of the potential approaches for managing the properties of drugs that are not ideal candidates for oral administration. It's also important to note that SEDDS can be produced in a number of solid dosage forms that can be administered parenterally as well as orally.*

Keywords- SEDDS, Bioavailability, BCS II

I. INTRODUCTION

SEDDS are employed for the treatment of poorly soluble and highly permeable chemical problems with inadequate bioavailability. Drugs that are hydrophobic can be dissolved in these systems and delivered as a unit dose form for oral administration. In situ emulsification, also known as self-emulsification, occurs when SEDDS formulation is released into the lumen of the GI tract and interacts with GI fluid to form a fine emulsion (micro/nano). This process causes the drug to become solubilized, allowing lymphatic pathways to absorb it without being affected by the hepatic first-pass effect. There are several in vivo characteristics of the lipid formulations that have been linked to this bioavailability-enhancing function, including(1)

- In order to prevent precipitation and re-crystallization of the medicinal ingredient, fine dispersions and micellar suspensions must be formed.
- The capacity of specific lipid substances and their metabolites to trigger alterations in the gastrointestinal fluid that favour enhanced medication absorption.
- Restricting the actions of cellular efflux systems, which keep medicines from being metabolised.

II. PURPOSE OF SEDDS

Self-emulsifying drug delivery systems (SEDDS) are a tried-and-true technique for making poorly soluble compounds more soluble and bioavailable. Oils, surfactants, and sometimes cosolvents make up SEDDS and isotropic mixes.

ADVANTAGES

- The fast-moving fine oil droplets of SMEDDS would promote widespread drug distribution throughout the GI tract and facilitate widespread drug distribution throughout the stomach, reducing the irritation that is frequently experienced during prolonged contact between bulk drug substance and the gut wall.
- SMEDDS are formulations that are physically stable, whereas emulsions are sensitive and metastable dispersed forms.
- In contrast to oily solutions, they offer a significant interfacial space for the medication to be partitioned between oil and water.

DISADVANTAGES

- Lack of effective predictive in vitro models for formulation evaluation is one of the challenges facing the development of SMEDDS and other lipid-based formulations.
- Conventional dissolve techniques are ineffective because these formulations may require digestion before the medication is released.
- The disadvantages of this approach include medication chemical instabilities and formulations

with high surfactant concentrations (about 30–60%) that aggravate the GIT.
- High production costs.
- Low drug incompatibility.
- Drug leakage. So it may allow less drug loading.[2]

III. SELF-EMULSIFYING DRUG DELIVERY SYSTEM COMPONENTS

Active Pharmaceutical Ingredient (API):

BCS class II medicines, such as itraconazole, nifedipine, vitamin E, simvastatin, danazol, ketoconazole, mefanimic acid, naproxen, and carbamazepine, are preferable because SEDDS are used to increase the solubility of poorly water-soluble medications.[3]

Excipients used in SEDDS:

The choice of excipients is extremely important when taking into account toxicity concerns as well as pharmacological acceptability. Therefore, there is a lot of restriction on what excipients should be utilised. The concentration and type of the oil/surfactant ratio, the surfactant/co-surfactant ratio, and the temperature at which self-emulsification takes place are all specific to the self-emulsification process. Therefore, this entire issue needs to be taken into account while choosing excipients for SEDDS[4]

TABLE-1 TYPE OF OILS USED IN MARKETED SEDDS

TYPES OF OIL	DRUG	MARKETED PRODUCT
Corn oil	Valproic acid	Depakene capsule
Sesame oil	Dronabinol	Marinol soft gelatin capsule
Soya bean oil	Isotretinoin	Accutane soft gelatin capsule

FACTORS AFFECTIG SEDDS

The drug's nature and dosage:

Very high doses of drugs are not appropriate for SEDDS unless they have excellent solubility in at least one of the components of SEDDS, ideally the lipophilic phase. The most challenging medications to deliver by SEDDS are those with limited solubility in water and lipids, often with log p values of around 2.The medication's solubility in oil phase has a significant impact on SMEDDS's capacity to sustain the drug in solubilized state.

Concentration of Surfactant or Co-surfactant:

If surfactant or co-surfactant is contributing more to the solubilization of the drug, there may be a risk of precipitation because SEDDS dilution will reduce the surfactant or co- surfactant's solvent capacity.

Polarity of the Lipophilic phase:

One of the elements influencing how drugs are released from microemulsions is the polarity of the lipid phase. The HLB, the length of the fatty acid chain and its degree of unsaturation, as well as the molecular weight of the micronized medication, all influence the polarity of the droplet.

MECHANISM OF SELF EMULSIFICATION:

Self-emulsification happens when there is an entropy (energy) change. The equation can be used to describe the free energy of traditional emulsion formation, which is a direct function of the energy needed to establish a new surface between the two phases.

$$\Delta G == \Sigma N \pi r^2 \sigma ...$$

N is the number of droplets with radius r, and is the change in interfacial energy over time. Here, G represents the process's associated free energy, disregarding the free energy of mixing. In order to decrease the interfacial area and, consequently, the system's free energy, the two phases of the emulsion will tend to separate.

Therefore, traditional emulsifying agents stabilise the emulsions produced by aqueous dilution. These agents create a monolayer surrounding the emulsion droplets, which lowers the interfacial energy and acts as a barrier to coalescence9. When a system self-emulsifies, the amount of free energy needed to create the emulsion is either very small, positive, or negative, and the emulsion process then happens on its own.[5]

Emulsification includes destabilisation by the contraction of small interfacial areas and requires relatively little energy input. The interfacial structure must not be resistant to surface shearing for emulsification to take place .[6]The ease with which water reaches the different liquid crystals or phases that form on the surface of the droplet can be related to emulsification. When an oil/non-ionic surfactant binary mixture is added to water, an interface between the oil

and aqueous continuous phases forms, which is followed by the solubilization of water within the oil phase as a result of aqueous penetrating through the interface. This process continues until the solubilization limit is reached close to the interface.(7)

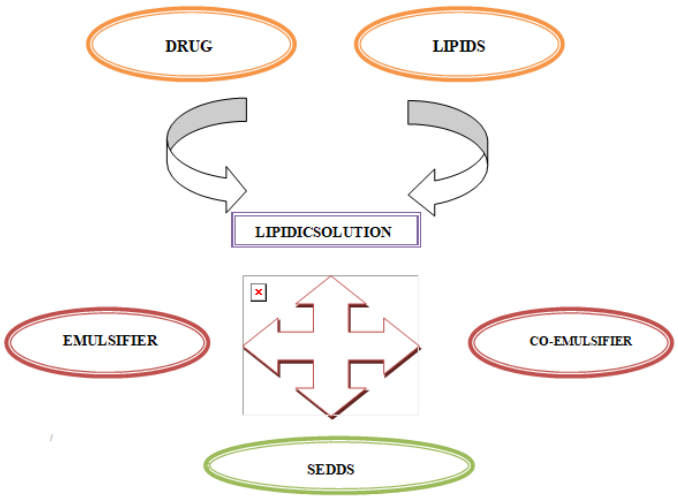

FIGURE-1.SCHEMATIC FLOWCHART ON SEDDS

IV. EVALUATION OF SEDDS

Drug Content	Liquefaction Time	Dispersibility Test	Droplet size analysis & Particle size measurements
Self-Emulsification Time	Robustness to Dilution	Thermodynamic stability studies	Turbid Metric Evaluation

APPLICATION OF SEDDS

Increasing oral bioavailability medicines with limited water solubility:

Dissolution rate dependent absorption is a significant component that restricts bioavailability in the case of medications that are not well soluble in water. The ability of SEDDS to release the medication into the gastrointestinal tract and dispersion into a microemulsion (globule size between 1-100 nm). Since the globules are so small, an increase in specific surface area makes it possible for drugs to be transported more effectively through the intestinal aqueous boundary layer and the absorptive brush border membrane, which improves bioavailability.

SEDDS are capable of delivering macromolecules

like as peptides, hormones, enzyme substrates, and inhibitors while preventing their enzymatic breakdown. These systems form naturally without the use of energy or heating, making them appropriate for thermo-labile pharmaceuticals like peptides. For instance, if Polysorbate 20 is used as an emulsifier in the formulation of a micro-emulsion, the intestinal hydrolysis of pro-drugs by cholinesterase can be protected.(8)

V. CONCLUSION

Drug, lipid phase, emulsifier, and/or co-solvent mixes make up self-emulsifying drug delivery systems. SEDDS are a potential strategy for medications with poor water solubility and can therefore be more beneficial for BCS Class II and IV medications as soon as they are administered. When the dosage form is delivered to the G.I.T., the SEDDS system draws water from the environment and creates an oil-in-water emulsion that spontaneously breaks down into tiny droplets. The smaller droplets have more surface area, which increases the drug's ability to dissolve or permeate the surrounding medium. SEDDS are typically manufactured in liquid dosage forms, but due to their convenience of handling, transportation, and superior stability, solid SEDDS (tablets, capsules, beads, microspheres, etc.) are preferred.

REFERENCESSS

[1] Mistry R, Sheth N S: Self emulsifying drug delivery system.International Journal of Pharmacy and Pharmaceutical Sciences 2011; 3(2): 23-28.
[2] Chouksey r, et al: Preparation and evaluation of the self-emulsifying drug delivery system containing atorvastatin HMGCOA inhibiter. International Journal of Pharmacy and Pharmaceutical Sciences 2011; 3(3): 147-15.
[3] Kumar S, Gupta S and Sharma P K: Self-Emulsifying Drug Delivery Systems (SEDDS) for oral delivery of lipid based formulations. African Journal of Basic & Applied Science 2012;
[4] Kumar S, Malviya R, and Sharma P K: Solid Dispersion: Pharmaceutical Technology for the Improvement of Various Physical Characteristics of Active Pharmaceutical Ingredient;African Journal of Basic and Applied Science 2011; 3(4): 116- 125.
[5] Christopher Porter J H, et al: Enhancing intestinal drug solubilization using lipid- based delivery systems. Advanced Drug Delivery Reviews 2008; 60: 673–691.
[6] Kumar A, Sharma S, Kamble R: Self-emulsifying drug delivery system (SEDDS): future aspects. International Journal of Pharmacy and Pharmaceutical Sciences 2010; 2(4): 7-13.
[7] Mittal P, Seth N, Rana AC: Self-microemulsifying drug delivery system (SMEDDS): An alternative approach for

hydrophobic drugs. International Journal of Natural Product Science 2012; 1: 80

[8] Xiaole Qi, et al: Self-double-emulsifying drug delivery system (SDEDDS): A new way for oral delivery of drugs with high solubility and low permeability. International Journal of Pharmaceutics 2011; 409(1-2): 245–251.