Review Article

Self-Emulsifying Drug Delivery System (SEDDS) - An Overview

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ABSTRACT

Self-Emulsifying Drug Delivery System (SEDDS) owns a promising future in enhancing solubility and bioavailability properties of sparingly water-soluble drugs. These are mixtures of drug, lipid, surfactants and oils. SEDDS are liquid to semisolid in nature, but it has some draw backs like formulation development, quality control, stability etc. To overcome this, liquid SEDDS can be converted into solid SEDDS such as pellets, tablets, capsules, microspheres, nanoparticles, microbeads, suppositories etc. without affecting drug release property. This article outlines the compilation of data on necessary aspects of self-emulsifying formulation such as excipients used, various dosage forms, novel ways to transform liquid SEDDS to solid SEDDS, it's applications and making way for further advancements in pharmaceutical investigation.

Keywords: Self-Emulsifying Drug Delivery System (SEDDS), bioavailability, lipid formulation system, solidification, characterization.

INTRODUCTION

Self-emulsifying drug delivery system is defined as isotropic mixtures of natural or synthetic oils, solid, liquid surfactant or one or more hydrophilic solvents[3].

These systems have the ability to create fine oil in water emulsions with gentle agitation and dilution in aqueous medium, such as GI fluids. Formulations that self-emulsify easily disseminate throughout the GI tract, and the agitation required for self-emulsification is provided by the stomach and intestine digestive motility. The drug is then solubilized and absorbed through lymphatic pathways by passing the hepatic first pass effect. It has been documented that SEEDS improve oral absorption of a number of drugs through a variety of mechanisms, such as increasing membrane fluidity to aid in transcellular absorption, opening tight junctions to permit paracellular transport, and blocking cytochrome P450 enzymes to raise intracellular concentrations and stimulate lipoprotein [27].

The SEDDS are employed in problem solving the oral drug delivery of poorly water-soluble compounds[4]. The hydrophilic ingredient can be dissolved in an appropriate solvent before the formulations are filled into oral dosage forms to produce the desired result. The SEEDS may be able to give hydrophilic medications orally. The primary advantage of these methods is that the first rate-limiting phase of particle dissolution in the GI tract's aqueous media is by-passed by pre-dissolving the drug. But the issue is that when formulations disperse in the gastrointestinal tract, especially when a hydrophilic solvent is utilized, the medication may precipitate out of solution. There is reduced chance of precipitation upon dilution in the GI tract when a drug dissolves in a lipid vehicle because partition kinetics will favor the drug and remains in lipid droplets.

There are two types of self-emulsifying lipid formulations system:

- Self-emulsifying drug delivery system
- Self-micro emulsifying drug delivery system

Both SEDDS and SMEDDS are linked together to better drug release qualities. SEDDS formulation are simple binary system which contains lipophilic phase, surfactant and drug has ability to self-emulsify in GI fluids[5]. The droplet size in the range of 200nm-300nm which provides larger surface area for absorption and the dispersion has turbid appearance. And also, concentration of oil is 40-80%. However, SMEDDS formulation requires co-surfactant to create micro emulsion and they are having droplet size below 50nm and the dispersion is seen from optically clarity to translucent look. The concentrations of oil are less than 20%. Hence, particle size is smaller than that of a solid dosage form, thus it has a bigger surface area for absorption and dispersion and can readily pass through the gastrointestinal tract and be absorbed. So, the bioavailability of drug is increased.

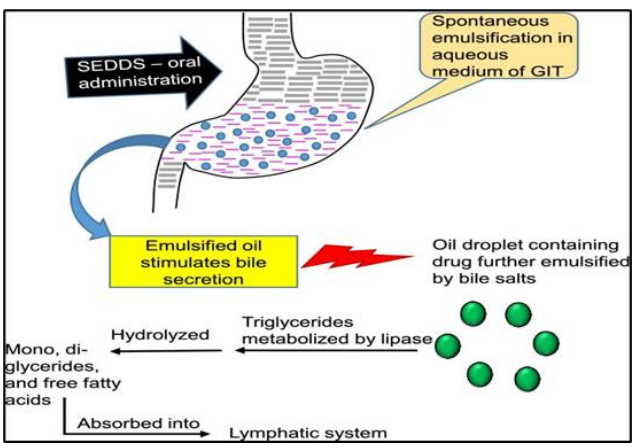

Figure 1: Process of self-emulsification[5]

COMPOSITION OF SEDDS

Self-Emulsifying Drug Delivery System (SEDDS) are composed of blend of oils, surfactants and sometimes co-surfactants /co-solvents. [3]

The effectiveness of formulation is determined by several factors: -

- Selection of oil-surfactant combination
- Surfactant concentration
- Temperature at which self -emulsification occurs

a. Oils

In SEDDS formulation oils are very essential excipient as they enhance the solubility of lipophilic drugs in a specific amount and aid in the self -emulsification process. This also promote the drug transportation via Intestinal lymphatic system, thereby increasing absorption from GI tract. Both long chain and medium chain triglycerides oil with varying saturation level is used in SEDDS formulation (e.g. sesame oil, olive oil, corn oil, beeswax) [16].

b. Surfactant

Compounds exhibiting surfactant properties may be used for designing of self-emulsifying system, the most widely recommended one being the non-ionic surfactant with a high hydrophilic-lipophilic balance (HLB) (e.g. Tween 80, Labrasol) [4,5]. The high HLB and hydrophilicity of surfactant assist the immediate formation of o/w droplets or spreading of the formulation in aqueous media. Surfactant are amphiphilic in nature that solubilize significant number of hydrophobic drugs, thereby enhancing drug absorption.

Non-ionic surfactant is relatively less toxic than ionic surfactant but may cause moderate reversible changes in intestinal wall permeability[4]. The usual concentration of surfactant ranges from 30-60% w/w in order to form a stable formulation. A large quantity of surfactant may cause GI irritation, so the safety aspect should be considered in each case.

c. Co-solvents

Organic solvent such as ethanol, propylene glycol (PG) and polyethylene glycol (PEG) are often used to improve the solubility of hydrophilic surfactant and lipophilic drug [21].

FORMULATION OF SEDDS

Formulation of SEDDDS include large variety of excipients available, such as oil, amphiphilic surfactant and water-soluble co-solvents. There are many different combinations that could be encapsulated in Hard / soft gelatin which disperse to give fine colloidal emulsions.

Table 1: Lipid Formulation Classification System (LFCS)[22,23]

Composition	Type I Oil	Type II SEDDS	Type III A SEDDS	Type III B SMEDDS	Type IV Oil free
Glycerides (MG, DG, TG)	100%	40-80%	40-80%	<20%	-
Water insoluble surfactant (HLB<12)	-	20-60%	-	-	0-20%
Water soluble surfactant (HLB>12)	-	20-40%	-	20-50%	20-80%
Hydrophilic co-solvents	-	-	0-40%	20-50%	0-80%
Particle size of dispersion (nm)	Coarse	100-250	100-250	50-100	<50
Significance of aqueous dilution	Limited importance	Solvent capacity unaffected	Some loss of solvent capacity	Significant phase changes and potential loss of solvent capacity	Significant phase changes and potential loss of solvent capacity
Significance of digestibility	Crucial need	Not crucial but likely to occur	Not crucial but may be inhibited	Not required	Not require

The following points should be considered for the formulations of SEDDS

1. The selection of oils, surfactant & co-solvents based on the drug solubility [4].

2.Addition of a drug to a SEDDS:

It is a critical step because the drug interferes with the self-emulsification process leading to change in oil-surfactant ratio

Thus, the formulation of SEDDS require pre-formulation studies (for selection of oil) and phase diagram studies (for identifying the self-emulsification region).

Mechanism of self-emulsification process

Self-emulsification occurs through a change in entropy, which impacts the free energy associated with the process[5]. The free energy involved in forming a conventional emulsion is proportional to the energy required to create new surfaces between the two phases. This can be expressed by the following equation:

$$\Delta G == \sum N \pi r^2 \sigma \quad \ldots\ldots (1)$$

Where, Δ G is the free energy associated with the process (ignoring the free energy of mixing), N is the number of droplets of radius r, σ is interfacial energy with time. [10]

In emulsions, the two phases naturally tend to separate to minimize the interfacial area and thus, the system's free energy. Traditional emulsions are stabilized by emulsifying agents that form a monolayer around the droplets, reducing interfacial tension and preventing coalescence. In self-emulsifying systems, the free energy required to form the emulsion can be either very low, positive, or negative, allowing the process to occur spontaneously. These systems require minimal input energy and lead to destabilization through the contraction of localized interfacial regions. For successful emulsification, the interfacial structure must allow for surface shearing without resistance. The ease of emulsification is often linked to how water penetrates various liquid crystalline phases or forms on the droplet surface. When a binary mixture (e.g., oil and non-ionic surfactant) is introduced to water, it forms an interface between the oil and aqueous phases. Water then solubilizes within the oil phase as it penetrates through the interface until the solubilization limit is approached[19]. As water continues to penetrate, a dispersed liquid crystalline phase is formed. The extent of this phase depends on the surfactant concentration in the binary mixture. With continued water penetration, the materials near the interface eventually become liquid crystal. This process, combined with gentle agitation, disrupts the interface and promotes droplet formation. The high resistance to coalescence in these self-emulsifying systems is attributed to the liquid crystal interfaces that surround oil droplets.

Construction of pseudo-ternary diagram

Pseudo-ternary diagram helps to identify the best emulsification region of oil, surfactant and co surfactant combination. Two commonly used method to plot pseudo-ternary diagram dilution and water titration method.

a. Dilution method

In this method, mixtures with different ratios of surfactant, co-surfactant, and oil are prepared. These mixtures are then diluted with double-distilled water, and the resulting globule size is measured. The nano-emulsion region on the ternary phase diagram is identified where the desired globule size is achieved [5].

b. Water titration method

A pseudo-ternary phase diagram is constructed by gradually adding water to a homogenous mixture of oil, surfactant, and co-surfactant at room temperature[18]. The mixture is observed for transparency, indicating the micro-emulsion region. The final ratio of oil, surfactant, and co-surfactant is selected based on this diagram for SMEDDS preparation.

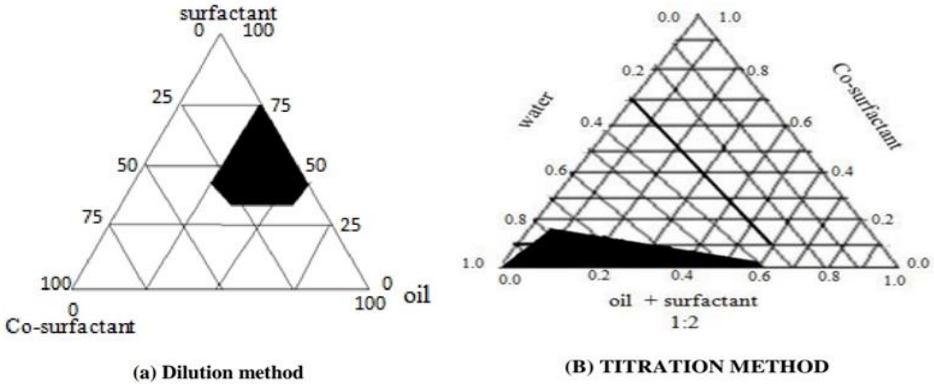

Figure 2: Ternary Phase Diagram [5].

SOLIDIFIATION TECHNIQUES FOR TRANSFORMING LIQUID/SEMISOLID SEDDS TO SOLID SEDDS

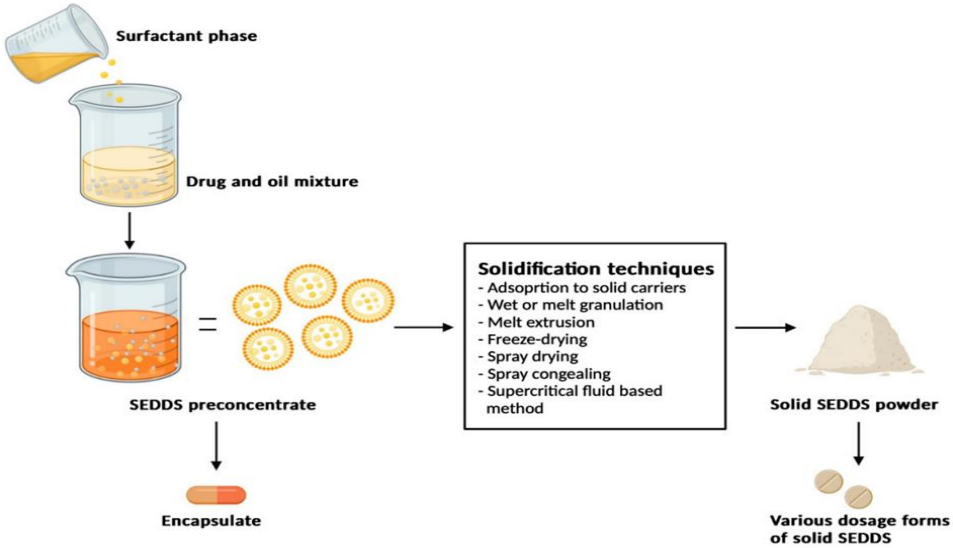

Figure 3: Formulation of SEDDS using solidification technique

Capsule Filling with Liquid and Semisolid Self Emulsifying Formulations

It is the most straightforward and widely used method for encapsulating liquid or semisolid SEDDS for oral administration[7]. Active material is added while stirring and semisolid excipient is heated above its melting point. The capsule is filled with this molten mixture and allowed to cool to room temperature[1].

Adsorption To Solid Carriers

Liquid SE formulations can be converted into free-flowing powders by adsorption onto solid carriers. Adsorption to solid carriers is achieved by simply coating the solid carriers with liquid SEDDS, which possesses adsorption property. A blender is used to mix the material until it is evenly adsorbed. The choice of solid carriers is crucial because the characteristics of these carriers—whether they are hydrophobic or hydrophilic—can affect the drug's characteristics. High levels of adsorption (up to 70% w/w) of SEDDS onto appropriate carriers are possible[25]. Microporous inorganic materials, high surface area colloidal inorganic adsorbent materials, crosslinked polymers, and nanoparticle adsorbed materials, such as silica, silicates, magnesium trisilicate, and magnesium aluminum silicate (Neu Silin), can all be considered solid carriers[9]. After that, powder can either be put straight into capsules or, if preferred, combined with appropriate excipients and then compressed into tablets.

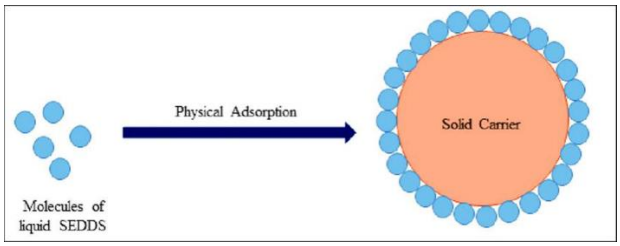

Figure 4: Schematic representation of solidification of liquid SEDDS by physical adsorption[8].

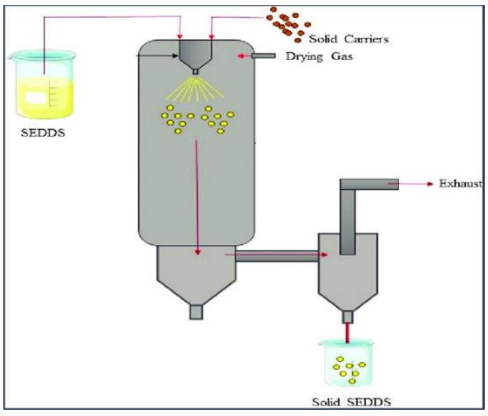

Figure 5: Process of conversion of liquid SEDDS into solid by Spray Drying method[8].

Spray Drying

During the spray drying process of SEDDS, lipids, surfactants, active ingredients, and solid carriers are mixed and solubilized[7]. With the help of regulated temperature and airflow, the solubilized liquid formulation is then atomized into a spray of droplets that enter a drying chamber and aid in the water evaporation from SEDDS to create the dried particles. These particles can be processed further to create tablets or capsules.

Spray Congealing

The method of spray congealing involves spraying the molten mixture into a cooling chamber. in which the fluid droplets solidify and then re-crystallize to form fine powders in the shape of spherical solid particles. After that, the fine powder might go through additional procedures to create other solid oral dosage forms, like tablets and capsules. To atomize the liquid mixture and produce droplets, a variety of equipment is available, such as ultrasonic, two-fluid, and rotary pressure atomizers[6].

Melt Granulation

Melt granulation is a technique that produces powder agglomeration by adding a binder that softens or melts at comparatively low temperatures. During high shear mixing, also known as the "melt-in" process, the binder can be mixed with the powder mix in either a solid or semi-solid form and allowed to melt (partial or totally) due to the heat produced by the friction of the particles. The powder particles and the molten binder combine to form tiny agglomerates, or granules, which are then further mixed under controlled circumstances to become spheronized pellets. The primary factors governing the granulation process are the viscosity of the binder, impeller speed, mixing duration, and binder particle size[7].

Melt Extrusion/ Extrusion Spheronization

It is a solvent-free process that allows high drug loading (60%) as well as content uniformity[9]. This formulation technique depends on the property of the plastic mass material which can be easily extruded and spheronised with pressure. Excipients in liquid form do not need to be added, but steady pressure and temperature must be maintained.

Dry emulsion

It is mostly O/W emulsion, which is then solidified by freeze-drying, solid carrier, or spray-drying techniques[4].

Lyophilization technique

When lyophilization or freeze-drying is used, heat and mass are transferred to and from the product that is being prepared. To create a lyophilized molecular dispersion, the drug and carrier are co-dissolved in a shared solvent, frozen, and sublimed. Three steps make up the lyophilization process: first, the product is frozen quickly, and then it goes through a main drying phase in which the majority of its water content is sublimated out. In order to create a stable and dehydrated powder, the third stage, referred to as secondary drying, removes any remaining water molecules[8]. The best stabilizing effects during the lyophilization of oil-in-water emulsions have been reported to be achieved by adding amorphous cryoprotectants and cooling at a slow rate.

RECENT ADVANCEMENTS IN SEDDS

This article will go over several more recent methods of solid self-emulsifying drug delivery systems and all the research that different candidates have done on them.

Self-Double Emulsifying Drug Delivery System (SDEDDS)

As double emulsions contain more surfaces than single emulsions, they are more unstable. The solution to this problem is to substitute SDEDDS for double emulsions. When it comes to improving the oral bioavailability of BCS class III drugs, SDEDDS have a lot of promise. There are two primary types of double emulsions: w/o/w emulsions, in which the external aqueous phase is continuously spread into huge oil droplets formed by the distribution of the aqueous phase. The oil membrane, which serves as a storage space for the hydrophilic drugs, will enclose the aqueous phase. Oil droplets dispersed among water droplets make up oil-in-water-in-oil (o/w/o) emulsions, which are then emulsified into a continuous exterior oil phase[16]. An aqueous barrier surrounds the internal phase, or oil phase, which will act as a storage space for hydrophobic drugs. There is no external water phase in SDEDDS.

Self-Emulsifying Tablets

Stability is the primary goal of this formulation. This system can be produced as a controlled release or sustained release formulation. Here, solid carriers are used to compress or mould the liquid self-emulsifying system into a tablet form. The optimized self-emulsifying tablet shows 80-90% drug release in 45 minutes. These tablets melt at body temperature, reducing the melting point and increasing emulsification rate due to GIT motility. Compared to non-emulsified tablets, self-emulsified tablets have higher concentration in the bloodstream.

A researcher created and tested an orlistat self-emulsifying pill[4]. The study examined how independent variables like oil volume and surfactant/co-surfactant ratio affect dependent variables like globule size and emulsification time across three levels. After 1 hour, the self-emulsifying pill released 99.53 % of drug, while the commercial version only released 39 %.

Self-Emulsifying Beads

SES loading into porous polystyrene beads (PPB) micro channels through solvent evaporation was studied[4]. And thereby using a smaller number of excipients, beads were formed. This formulation is chemically inert, biocompatible, and stable across various pH, temperature, and humidity levels. An experiment employed solvent evaporation to deposit the SE system into microporous polystyrene beads. Porous polystyrene beads (PPB) have complicated interior void formations. These beads are made by copolymerizing styrene and divinyl benzene. The geometric properties of porous materials, such as bead size and pore architecture, influence drug loading efficiency and in vitro release from SES-loaded polystyrene beads.

Self-Emulsifying Capsules

When a capsule containing a traditional liquid self-emulsifying formulation is administered, it spontaneously forms microemulsion droplets that spread throughout the GIT and results in better absorption. They do, however, have some limitations, such as a decrease in medication absorption if the microemulsion undergoes irreversible phase separation. In these situations, sodium dodecyl sulphate is added to SE formulations to increase absorption, and super-saturable SEDDS is created by incorporating a small amount of polymer into the formulation to create and maintain a supersaturated state in vivo, preventing drug precipitation. These formulations minimise any gastrointestinal side effects and contain less surfactant. Some controlled release capsules are made by coating the liquid-filled soft gelatin capsules with a thin layer of semipermeable polymeric material. Lipidic SE formulations offer long-lasting therapeutic effects due to their semipermeable properties. An inflatable layer can be added to the semipermeable layer to further control drug release from the capsule shell. This approach can effectively deliver a variety of drugs, including cardiovascular, anti-retroviral, anticancer, and corticosteroid medications[15].

Self-Emulsifying Implants

SE implants are now more useful due to advancements in research. E.g. 3-bis (2chloroethyl)-1-nitrosurea I.e. Carmustine, a chemotherapeutic drug, used in the treatment of malignant brain tumors. PGLA (polyd,1-lactide-co-glycolide), a self-emulsifying system composed of Labrafil 1944, tributyrin, and cremophor RH 40, was created. Compression modelling was used to manufacture self-emulsified carmustine wafers with a flat smooth surface. The introduction of a self-emulsified mechanism increased carmustine's half-life to 130 minutes. This formulation outperformed comparable carmustine wafers without a self-emulsifying mechanism in terms of anticancer efficacy, hydrolysis sensitivity, and overall effectiveness. Loomis developed copolymers with bioresorbable, hydrophilic, and at least two crosslinkable functional groups per polymer chain[15]. These copolymers exhibit SE properties without the use of an emulsifying agent & can serve as effective sealants for implantable prosthesis.

Self-Micro Emulsifying Mouth Dissolving Films (SMMDF)

SMMDF is made by combining self-emulsifying components with a mouth-dissolving film. This improves the absorption and solubility of hydrophobic medicines when administered orally. Some features of SMDDF include obstruction-free medication administration and improved mucoadhesion. It also disintegrates quickly (3-5 seconds) & drug release is faster. SMMDF are ideal for drugs with low aqueous solubility, high molecular weight, first pass metabolism, enzymatic degradation, gastric irritation, and low dissolution and bioavailability[16]. SMMDF is cost-effective because to its simple manufacturing process and minimal medication requirements. This is a new approach to

improving the oral bioavailability of lipophilic drugs & thus an industrially viable technology.

Self-Nano Emulsifying Transdermal Films

SNEDDS may increase dissolution rates and absorption levels due to the nano-sized droplets present, producing in more predictable blood-time profiles. SNEDDS dispersion in aqueous medium in a fine emulsion with nanosized globules, which keeps the drug in solution and overcomes the most major barriers to drug absorption, the dissolution step. Furthermore, emulsifying SNEDDS increase drug permeability across the GIT membrane, hence increasing bioavailability.

Khaled M Hosny developed a self-emulsifying film by loading a SQR SNEDDS formulation onto a polymeric PVA-based transdermal film. Saquinavir (SQR) SNEDDS were used to create transdermal films. SQR-SNEDDS and SNEDDS-loaded polymeric PVA transdermal films were successfully created through a two-step optimization process. Compared to pure SQR-loaded material, SNEDDS-loaded film demonstrated good folding durability and tensile strength. The study suggests that SNEDDS-loaded transdermal film improved bioavailability, patient compliance, and lower side effects.

Self-Emulsifying Suppositories

S-SEDDS may enhance drug absorption in the GI tract as well as in the rectum and vagina. The suppository bases [such as cocoa butter, macrogol esters, and saturated polyglycol zed glycosides] liquefy at body temperature after being administered rectally. The lipidic excipients are then subjected to emulsification in the presence of rectal fluid to create fine Nano emulsion/microemulsion (o/w type), which improves systemic bioavailability of medications and hastens their onset of action[28]. Glycyrrhizin can effectively treat chronic hepatic disorders using vaginal or rectal SE suppositories, as it achieves therapeutic plasma concentrations when taken orally[2]. The formulations used glycyrrhizin and a combination of C6-C18 fatty acid glycerol ester and C6-C18 fatty acid macrogol ester.

CHARACTERIZATION OF SEDDS

Several experiments are carried out for the characterization and evaluation of SEDDS.

Assessment of Self Emulsification

The USP 24 rotating paddle apparatus was used to assess the effectiveness of self-emulsification. A gram of each mixture was added to 200 ml of distilled water, gently agitated with a rotating paddle at 70 rpm and 37 °C. The self-emulsification process was monitored visually for both emulsification rate and emulsion appearance[2].

Zeta Potential Determination

This is used to determine the charge of droplets. In typical SEDDSs, oil droplets have a negative charge due to free fatty acids.

Zeta potential of diluted SEDDS formulations was measured with a Zeta Meter System. The SEDDS were diluted 1:2500 (v/v) with distilled water and swirled for 1 minute using a magnetic stirrer. Measuring the zeta potential in simulated gastric fluid (SGF) was challenging due to the media's high specific conductance, which limits the maximum tolerated voltage delivered through the cell[2]. The zeta potential in simulated intestinal fluid (SIF) did not differ appreciably from that of pure water. Distilled water is commonly used as a diluent for zeta potential measurements.

Self - Emulsification Time

To determine the self-emulsification time, use USP dissolution equipment 2 at 50 rpm. Add 0.5 g of SEDDS formulations to 250 ml of 0.1N HCL or 0.5% SLS (Sodium Lauryl Sulphate) solution. The time required for emulsification at room temperature is referred to as self-emulsification time in the formulation. SEDDS method is typically delivered via soft or hard gelatin capsules. The system should be easy to pour into capsules and not too thick to cause issues. The rheological parameters of the micro emulsion are examined using a Brookfield viscometer. The viscosity determination depends on whether the system is w/o or o/w[5]. A system with low viscosity is considered o/w type, while a system with high viscosity is classified as w/o type.

Viscosity determination

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Thermodynamic Stability Studies

Precipitation of drug in the excipient matrix might negatively impact the physical stability of a lipid-based formulation, compromising its performance. Poor formulation stability can cause excipient phase separation, affecting both performance and appearance. Incompatible formulations with gelatin capsules can cause brittleness, delayed disintegration, and inadequate drug release.

I. **Heating Cooling Cycle**: Involves six cycles of cooling and heating at temperatures ranging from refrigerator (4°C) to high (45°C) for at least 48 hours each. Stable formulations are next tested under centrifugation.

II. **Centrifugation:** Formulations that pass the heating-cooling cycle are then centrifuge at 3500 rpm for 30 minutes. Formulations with no phase separation undergo freeze-thaw stress testing[4].

III. **Freeze Thaw Cycle**: After three freeze-thaw cycles at -21°C and 25°C, mixtures that pass this test exhibit good stability, with no phase separation, cracking, or

creaming. Formulations that pass this test are subsequently examined to dispersibility test.

Dispersibility Test

The efficacy of self-emulsification of an oral nano or micro emulsion is evaluated using a conventional USP XXII dissolving device 2. One milliliter of each formulation was mixed with 500 mL of water at 37 ± 0.5 0C. A basic stainless steel dissolution paddle that rotated at 50 rpm offered mild agitation. The formulations' in vitro performance is evaluated visually using the grading system below:

▪ **Grade A:** This nano emulsion forms quickly (within 1 minute) and appears transparent or bluish.

▪ **Grade B:** The emulsion forms rapidly, is slightly less clear, and appears bluish white.

▪ **Grade C**: A fine milky emulsion is formed within 2 minutes.

▪ **Grade D**: The emulsion is dull, greyish white, and slightly oily. It takes longer than 2 minutes to emulsify.

▪ **Grade E:** These are the formulations with low emulsification and big oil globules on the surface. Grade A and B formulations will remain nano emulsions when released in GIT. Formulations of Grade C may be suitable for SEDDS formulation[5].

Robustness to Dilution:

Emulsions that do not display phase separations or drug precipitation after 12 hours of storage are called robust to dilution[5].

***In vitro* diffusion study:**

Using the dialysis approach, *in vitro* diffusion tests are conducted to examine the drug release behaviors of formulations from liquid crystalline phase surrounding the droplets. This technique involves phosphate buffer (pH 6.8) as the dialyzing medium. Tie one end of the dialysis membrane with a thread, then add 1 ml of SEDDS formulation and 0.5 ml of dialyzing medium. The membrane is secured with thread and rotated in the dialyzing media at 100 rpm using a magnetic stirrer or dissolution device. Samples are collected at various times and analyzed after appropriate dilution. The volume of withdrawn samples is refilled with new dialyzing medium.

Cryo-TEM Studies:

Samples for Cryo-Transmission Electron Microscopy (TEM) were prepared in a verification system with a controlled environment. To create a thin liquid film on the grid, a little, weighed amount of sample is placed on carbon film that is supported by a copper grid and wiped with filter paper. At -180° C, the grid is quenched in liquid ethane and then moved to -196° C in liquid nitrogen. A TEM microscopy was used to characterize the samples.

APPLICATION OF SEDDS

1. Improved solubility and bioavailability[2].
2. Protection from biodegradation.
3. SEDDS enable oral administration of lipophilic drugs.
4. SEDDS may transport macromolecules like peptides, hormones, enzyme, substrates and inhibitors[5].
5. SEDDS addressed issues related to delivering poorly soluble drugs.
6. Super-saturable SEDDS (S-SEDDS) can lessen adverse effects of surfactants. S-SEDDS formulation has a better toxicity, safety profile than the traditional SEDDS formulation[5]

ADVANTAGES OF SEDDS[5]

1. It improves oral bioavailability of poorly water-soluble drugs and transport the drug in structured manner.
2. It works well for oral delivery of hydrophobic drugs with sufficient solubility in oils or surfactants blend[24].
3. It is easy to manufacture and scale up which is the most significant advantage.
4. It protects the drugs from antagonistic environment in gut.
5. The main advantage of this over other solid dosage formulation is that it bypasses slow drug dissolution.
6. It has greater drug loading capacity which enables greater potency and efficacy of the formulation.
7. Lower levels of drug used in SEDDS compared with conventional formulations means less incidences of side-effects to consumers.
8. Small droplets of oil are distributed more uniformly within the GI tract which enhances absorption and bioavailability.

DISADVANTAGES OF SEDDS

1. Increase number of surfactants in SEDDS formulation can lead to GI side-effects[24].
2. Volatile co-solvents immigrate into shells of gelatin capsules which results in precipitation of lipophilic drugs[5].
3. Liquid SEDDS formulations can experience drug leakage.
4. The lipid component of SEDDS has potential to oxidize.
5. SEDDS can experience problems with encapsulation.

6. It can be expensive to manufacture.

CONCLUSION

SEDDS are mixtures of drug, lipid, emulsifier or co-solvent. Delivery of hydrophobic drugs is achievable because of SEDDS which have been demonstrated to enhance the pharmacokinetic properties of drug by which the absorption and dissolution of the drug is fastened. SEDDS is an effective strategy for insoluble drugs mostly which comes under BCS class II and IV. SEDDS are formulated as liquids, also in solid dosage form for effortless transit and steadiness. It prevents GI discomfort and controlled and even release of drug is accomplished. SEDDS will proceed to facilitate implementation in drug delivery and also further research will bring a comprehensive availability of self-emulsifying formulations.

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