RESEARCH ARTICLE

Enhancement of Solubility and Dissolution Rate of Poorly Soluble Drug Nifedipine by Solid Sedds

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ABSTRACT

Nifedipine is a dihydropyridine calci channel blocking agent belongs to biopharmaceutical classification system (BCS) class-II mainly applied in the treatment of hypertension and angina-pectoris. The objective of this work is to improve the solubility and dissolution rate of nifedipine by formulating into a solid-self micro emulsifying drug delivery system (solid smedds). Methods: Oil, Surfactant, and cosurfactant were selected by solubility screening study. For the determination of the best emulsion region, a pseudo ternary diagram was prepared. Based on solubility castor oil, tween 80 and polyethylene glycol (PEG) 400 was selected in which SCOSmix (a mixture of surfactant and cosurfactant) was 1:1. Thermodynamic stability study was performed for the determination of stable smedds formulation. These formulations were evaluated for self emulsification time, drug content analysis, robustness to dilution test, particle size analysis, and in vitro diffusion study. The optimized formulation was selected for formulating into solid-smedds by using aerosil 200 at a different ratio. SCF9L (0.65:1) was selected due to its good flow property. Then it was evaluated for particle size analysis, drug content study, differential scanning calorimetry (DSC), X-Ray Diffraction study (XRD), fourier transform infrared spectroscopy (FTIR) Scanning Electron Microscopy study (SEM) analysis, and in vitro dissolution study. Results: DSC and XRD result shows that the drug within the formulation was in the amorphous state. From the SEM analysis, the texture of powder showed a uniform granular structure, and there was no incompatibility between drugs. Excipients was observed from ftir study. From the in vitro dissolution study, it improved the dissolution rate of nifedipine, which was 98.68% of drug release, where pure drug release only 6.75%.

Keywords: Adsorption technique, Aerosil200, Dissolution rate, Liquid smedds, Solid smedds, Solubility

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INTRODUCTION

Around 40% of recent drug candidates become poor water solubility and also the oral deliveries of those medicines is usually related to high intrasubject and inter-subject variability, a lack of dose proportionality, low bioavailability. To overcome those issues, several formulation ways are utilized together with specific utilization of surfactants, lipids, permeation enhancers, micronization, salt formation, cyclodextrins, and solid dispersion. Newly, the lipid-based formulation has gained a lot of attention with special importance on self-emulsifying drug delivery systems (SEDDS), which is used to boost the bioavailability of orally administered lipophilic drugs. Sedds or self-emulsifying oil formulations (SEOF) outlined as isotropic mixtures of natural or synthetic oils, solid or liquid surfactants, or instead, one or additional hydrophilic solvents and co-solvents/ surfactants.[1] On delicate agitation, these systems will form fine o/w emulsions (oil-in-water) or self micro emulsifying drug delivery system (smedds) or microemulsions followed with dilution into liquid media, like epithelial duct (GI) fluids.[2]

Nifedipine is a dihydropyridine calcium channel antagonist that belongs to BCS class-II mainly applied in the treatment of hypertension and angina-pectoris administered by the oral route. Drug release is a vital and rate-limiting step, mainly for drugs with low solubility and high permeability, i.e., BCS class II drugs. Sedds is the technique that can be used to enhance the solubility and dissolution rate of poorly water-soluble drugs.

But Liquid sedds having problems like the irritating effect of a high percentage of surfactant on the gastrointestinal mucosa, lower formulation stability, and plausible interaction of excipients with capsule shell. To surmount these ostensible problems associated with l-sedds a new technology is investigated known as s-sedds.[3]

supersaturatable self-emulsifying drug delivery systems (S-SEDDS) are the solidified self-emulsifying formulation which is prepared by converting liquid/semisolid sedds into self-emulsifying powders, nanoparticles by using various solidification techniques such as, nanoparticle technology, melt extrusion, spray drying, and adsorptions to solid carriers.[4]

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MATERIALS AND METHODS

Materials

Nifedipine was gift sample from G.C. Chemie Pharmie Ltd; Mumbai, India. Almond oil, Soybean oil, castor oil and linseed oil were supplied by Merck Pvt. Ltd. Tween 80, tween 20, tween 40, span 20 were supplied from Sisco research laboratories Pvt. Ltd. PEG 400, PEG200, propylene glycol, glycerol, PEG 600 were supplied from Sisco research laboratories Pvt. Ltd. Aerosil 200 was supplied from yarrow Chem product Pvt. Ltd.

Solubility Screening Study

The shake flask method is used to determine the solubility of nifedipine in various vehicles. Approximately in 5 mL of each vehicle, excess amount of drug (500 mg), was added and kept in sealed vials. Then the mixture was shaken for 72 hours. in water bath shaker to reach in a uniform equilibrium state. After that, the mixture was centrifuged at 5000 rpm for 15 minutes. using a centrifuge (Remi centrifuge equipment). Then the supernatant was filtered using Millipore (0.45 µm) and diluted in phosphate buffer pH 6.8. Then the prepared sample was quantified using a UV-vis spectrophotometer at λ_{max} 238nm.[5]

Construction of Ternary Phase Diagram

After the selection of higher drug solubility containing excipients (oil, surfactant, and cosurfactant), pseudo ternary phase diagram was prepared. Oil, water, mixture of surfactant and cosurfactant were variables in which surfactant and cosurfactant were mixed at 1:1 and 1:2 ratios. Pseudo ternary diagram was done by using a water titration method. In this method, water was titrated dropwise into the different self-emulsifying system (1:9 to 9:1) in which the mixture of surfactant and cosurfactant was 1:1 and 1:2. After that, visual observation was carried out to check the formation of transparent o/w microemulsion. The pseudo ternary phase diagram was constructed using software Chemix School (ternary software).

Preparation of Smedds of Nifedipine

Different smedds formulations were prepared by using oil (castor oil), surfactant (tween 80), and co-surfactant (PEG 400). In each formulation, the accurate amount of nifedipine (i.e-100mg/10mL) was dissolved in oil by using vortex mixture. In another vial, the surfactant and cosurfactant was mixed properly by using vortex mixture. After that, the mixture of surfactant and cosurfactant was mixed gently with drug-containing oil. The prepared mixture was mixed with the help of a magnetic stirrer and warmed at 40°C until a homogenous mixture was made.Then the prepared homogenous mixture was stored at 25°C for further studies.

Thermodynamic Stability Studies

All the smedds formulations were diluted with distilled water and centrifuged at 3500 rpm for 15 minutes. and check for any phase separation or clear emulsion. Then it was exposed to heating-cooling cycle(4°C and 45°C) and freeze-thaw stress cycle(-21°C and + 25°C) with storage at each temperature for not less than 48 hr. All the testing was done in triplicate and observes the extent of phase separation.[6]

Self Emulsification Time

After thermodynamic stability testing, the stable formulations were taken for visual assessment self emulsification efficiency. Selfemulsification efficiency study was performed in the USP XXIV type II dissolution apparatus. 1 mL of each smedds formulation was added dropwise into 500 mL of distilled water and maintained at 37°C with a rotating speed of 50 rpm. Then the time is noted for complete emulsification in distilled water.[7]

Droplet size analysis

The droplet size of smedds formulation was determined using a zeta sizer Nano ZS (Malvern instrument, UK) dynamic light scattering particle size analyzer at a wavelength of 635nm and at a scattering angle of 90°C at 25°C. The formulation (0.1 mL) was diluting with 100 times with double distilled water and sonicated for at least 30 minutes for the reduction of particle size of emulsion.[8]

Effect of pH and Robustness to Dilution

All the formulations were taken for checking the robustness of emulsion in diluting with enzyme-free phosphate buffer ph6.8 (simulated intestinal fluid) and 0.1N HCL (simulated gastric fluid). 1ml of each formulation was subjected to 50, 100, 500, 1000 fold dilution and kept them for 24 hours. After that, all the formulations were checked for any change in physical appearance, i.e., a coalescence of oil droplets, drug precipitation, or phase separation.[9,10]

In vitro Diffusion Studies of SMEDDS

The drug release experiment was performed in USP XXIII rotating paddle method using a dialysis bag method. The dialysis membrane was shocked in dialysis media (buffer pH 6.8) for 12 hours. at room temperature.[6] After that, the l-SMEDDS (liquid self micro emulsifying drug delivery system) containing 100mg of nifedipine was filled into soaked dialysis membrane and closed both sides of the dialysis membrane by using thread. Then it was put into the vessel containing 900ml of phosphate buffer pH 6.8 carefully by which the dialysis membrane can easily rotate. The dissolution was performed at 37 ± 0.5°C for and rotated at 50 rpm for 120 minutes. At a specific time interval, i.e., 15, 30, 45, 60, 75, 90, 105, 120, the aliquote of 5mL was withdrawn and filtered through a 0.45µm membrane filter. The same volume of the withdrawn amount should be replenished to maintain sink condition of dissolution. The concentration of nifedipine was determined by spectrophotometrically at 238 nm. The dissolution of each formulation was performed in triplicate times. The dissolution profile of stable formulations were prepared and compared with the dissolution profile of pure drug.[11]

Preparation of Solid-SMEDDS

Solid self-emulsifying powder formulation was prepared by using adsorption to solid carrier method, which is very simple and reliable technique. The optimized formulation was

taken for solid-smedds preparation. Aerosil 200 was used in a different ratio to prepare solid smedds in the ratio of 0.5:1, 0.55:1, 0.65:1 (adsorbent: liquid smedds). The adsorbent and liquid smedds were mixed in a porcelain dish until uniform; the homogenized free-flowing powder was obtained. Then the powder was passed through sieve no. 120 and dried at ambient temperature for further use. These formulations were evaluated for flow property. The developed, optimized formulation was characterized for particle size analysis, percentage of drug content and *In vitro* dissolution study, SEM, XRD, DSC and FTIR study. The evaluation study was carried out for optimized formulation and compared with pure drug.

Flow Properties of s-smedds

Flow properties of solid smedds were determined by Carr's method. All the samples (0.5:1, 0.55:1 and 0.65:1) were poured through the funnel in which the height of powder and its radius was obtained. The angle of repose was calculated using equation tan θ= H/r. The powder preparation having good flow property was selected as an optimized formulation and taken for particle size analysis and drug content analysis[8].

Solid-state Characterization of Optimized Solid Self Micro Emulsifying formulation

The optimized solid-smedds was analyzed for FTIR, DSC, XRD, and SEM analysis to investigate its solid-state properties. DSC thermogram was analyzed in Mettler Tolledo DSC. FTIR analyzes the compatibilities between drug and excipients present in the formulation. Each sample were scanned in the FTIR spectrophotometer (Spectrum 2 FTIR spectrophotometer, Perkin Elmer) at a range of 4000-400cm-1. The XRD analysis of the sample was analyzed in an x-ray diffractometer (Rigaku Ultima IV, Japan), and SEM of self-emulsifying powder was performed in SEM instrument (Zeiss EVO 18 special edition).

Statistical data analysis

For the data analysis, one-way analysis of variance (ANOVA) was used to compare the difference between solid-smedds, liquid smedds, and pure drugs by using mean value ± standard deviation (SD).

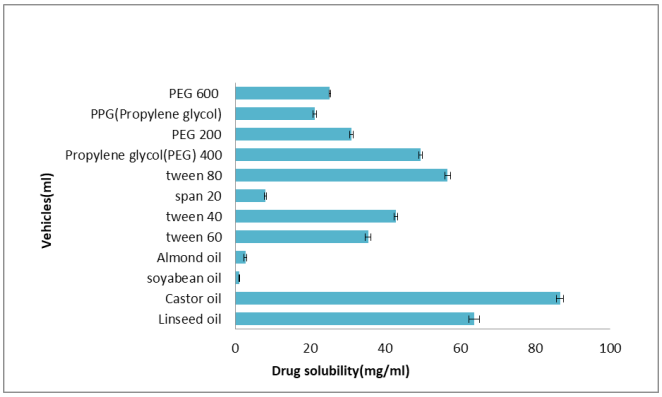

Figure 1: Solubility studies of Drugs in Various oil, surfactant, and Co-surfactant.

RESULTS AND DISCUSSION

Solubility Screening Studies

Self-emulsifying preparation is a monophasic clear emulsion that contains oil, surfactant, Co-surfactant. For the analysis of solubility with nifedipine, castor oil, linseed oil, soybean oil, and almond oil were as oil, tween 60, tween 40, span 20, and tween 80 were as a surfactant, and PEG 400, PEG 200, PPG, PEG 600 were taken as cosurfactants. The results of solubility in various vehicles were represented in Figure 1. From the analysis, it has been shown that nifedipine shows high solubility in Castor oil (86.64 ± 0.92 mg/mL), Tween 80 (56.59 ± 0.76 mg/mL), PEG 400 (49.43 ± 0.48 mg/mL). Castor oil is natural and long-chain triglyceride oil, which has good solvent capacity for dissolving drugs. Tween 80 is a hydrophilic nonionic surfactant that has good solubilizing capacity[12] and PEG 400 as co-surfactant, which lowers the interfacial tension.[6]

Pseudo-ternary Phase Diagram

Proper concentration of vehicles that produce stable emulsion must be essential to prepare self-emulsifying formulations. The pseudo ternary phase diagram defines the ternary phase behavior between components and provides proper concentration to prepare a stable emulsion. After water titration, the amount of water used was noted and developed the ternary phase diagram by using ternary software, which has written in the method part. Figure 2a and b represents ternary phase diagram of smedds between castor oil, tween 80 and PEG 400 (blue colored region indicate the region of self-emulsification produced by SCOSmix 1:1 ratio and 1:2 ratio. The ternary diagram indicates that among both the SCOSmix ratio, 1:1 ratio provides a wide self emulsification region. So this ratio was taken as a superlative ratio for preparation smedds.[13]

Preparation of SMEDDS of Nifedipine

From the data suggested from ternary phase diagram, smedds preparations were prepared by using castor oil, tween 80, and PEG 400 in which mixture of surfactant and cosurfactant was taken as 1:1 ratio. 100 mg of nifedipine was dissolved in all formulation. A series of nine formulations were prepared (CF1L to CF9L), among which four formulations (CF1L,

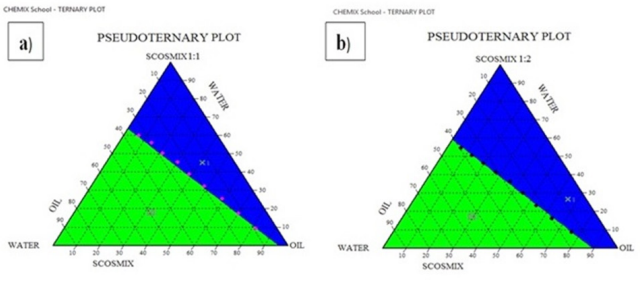

Figure 2: Represents ternary phase diagram of SMEDDS between castor oil, tween 80, and PEG 400 (blue colored region indicate the region of self-emulsification produced by SCOSmix 1:1 ratio (a) and 1:2 ratio (b).

CF2L, CF3L, and CF4L) had shown phase separation, maybe due to high concentration of oil that interrupt in keeping the formulation stable. The other five formulations were stable and taken for the thermodynamic stability study. Table 1 provides the data observed from the formulations when kept them for 24 hours at room temperature.

Thermodynamic Stability Study

Five formulations showed stability, i.e., there was no phase separation, the appearance of coalescence of oil droplets or any cracking appearance after keeping them for 24 hr. of storage. The data of performance during thermodynamic stability testing was given in Table 2. These five formulations were taken for the centrifugation test, heating cooling process, and freeze-thaw stress testing. From the result of thermodynamic stability testing, five formulations were remaining stable after centrifugation testing and heating-cooling process. But CF5L formulation didn't withstand freeze-thaw stress testing and shown instability.

Characterization of Self-emulsification Efficiency, Particle Size Analysis, Drug Content Analysis, Viscosity Study

Emulsification efficiency was carried out in enzyme-free simulated gastric fluid (pH1.2) and simulated intestinal fluid (pH 6.8). Table 2 provides the data of self emulsification time of four formulations in enzyme-free simulated gastric fluid (pH1.2) and simulated intestinal fluid (pH 6.8). In pH 1.2, only CF6L and CF7L was taken self-emulsification time more than 1min. But in pH 6.8, all the formulation produced transparent and clear liquid, and the time was taken less than 1 minute (Table 3).

Particle size analysis showed that all the formulation showed a globule size less than 250 nm. So all the formulation has lied in the microemulsion region. CF9L formulation showed 246.8 nm, which was less droplet size as compared to the other three formulations. It may be due to the presence of a high amount of surfactant and cosurfactant present in the formulation. As the concentration of oil decreased, the globule size is decreased (Table 3).

From the drug content analysis, the result showed that three formulations, CF6L, CF7L, and CF8L contained 70–79%. But as the concentration of surfactant and cosurfactant increased in CF9L formulation, the percentage of drug content was increased to 84.47% (Table 3).

From the analysis of the viscosity of four formulations, CF6L formulation was less viscous as compared to the other three formulations. But CF9L was more viscous (184.5); it may be due to the content of a high amount of surfactant and cosurfactant, which provides viscosity to the formulation (Table 3).

Robustness to dilution test

All the four formulations didn't show any drug precipitation in both the diluents after 24 hours. of storage at room temperature. But CF6L showed phase separation in both the diluents due to the presence of high concentration oil in comparison to other formulation.

Table 1: Provides the Analysis of the Physical appearance of all smedds after 25°c.

	Observation after 24 hours. at 25°C	
Formulation	*Appearance*	*Stability checking*
CF1L(9:1)	Milky	Unstable; Phase separation
CF2L(8:2)	Milky	Unstable; phase separation; cracking appearance
CF3L(7:3)	Milky	Unstable; phase separation
CF4L(6:4)	Milky	Unstable; coalescence of oil droplets
CF5L(5:5)	Milky	Stable; no phase separation, cracking appearance and no coalescence oil droplets
CF6L(4:6)	Transparent	Stable; no phase separation, cracking appearance and no coalescence oil droplets
CF7L(3:7)	Transparent	Stable; no phase separation, cracking appearance and no coalescence oil droplets
CF8L(2:8)	Transparent	Stable; no phase separation, cracking appearance and no coalescence oil droplets
CF9L(1:9)	Transparent	Stable; no phase separation, cracking appearance and no coalescence oil droplets

Table 2: The performance of smedds formulation during thermodynamic stability studies.

Formulations	*Heating cooling cycle*	*Centrifugation test*	*Freeze-thaw stress cycle*
CF5L	✓	✓	×
CF6L	✓	✓	✓
CF7L	✓	✓	✓
CF8L	✓	✓	✓
CF9L	✓	✓	✓

Table 3: Provides the data from self emulsification study, drug content analysis, particle size analysis and viscosity study of stable smedds formulation

	Emulsification time(second)				
Formulation	*pH 6.8*	*pH 1.2*	*Drug content (%)*	*Particle size(nm)*	*Viscosity(cp)*
CF6L	00:46	01:30	70.64%	249.6	182.5
CF7L	00:41	01:20	75.12%	248.4	182.7
CF8L	00:31	00:40	79.65%	247.7	183
CF9L	00:25	00:35	84.47%	246.5	184.5

In vitro diffusion study of optimized smedds formulation

From the robustness to the dilution test, CF6L was not considered for *In vitro* drug diffusion study. The in-vitro diffusion study was carried out using dialysis media phosphate buffer pH 6.8 at 50 rpm at temperature 37 ± 0.5°C. The diffusion analysis of three formulation, i.e., CF7L, CF8L, CF9L, was performed for 2 hours in media using a dialysis bag method. The diffusion of the drug from prepared smedds and pure drug was clearly indicated in Figure 3. A result of *In vitro* diffusion studies was indicated that CF9L formulation showed more drug release of 76.93% at 2 hours while pure drug release nifedipine only 6.75% at 2 hours CF7L and CF8L release 55.15% and 64.61%, which was less in comparison to CF9L formulation. Because these formulations contain more oil and less surfactant concentration, which produces interruption with the release of drugs into the dissolution media. Drug release at 120min was compared between CF9L formulation and pure drug using one way ANOVA. The mean value and standard deviation of all smedds preparation and pure drug was suggested that, nifedipine release from CF9L formulation much faster and higher in comparison to pure drug. At 120 min. drug release from CF9L r was significantly higher than pure drug ($p < 0.05$). When SEDDS were exposed to aqueous media, it produces oil in water (o/w) microemulsion, having small globule size. The small globule size permitted drug release at rapid rate from microemulsion.

Preparation solid smedds of nifedipine

The formulation CF9L was selected as an optimized formulation for formulated into solid-smedds preparation. Because it was required less self-emulsification time, good thermodynamic stability at all temperature and condition, having less droplet size, good robustness to dilution, and a higher percentage of drug release in comparison with the other two formulations. Aerosil 200 was selected as inert solid adsorbent for preparation of free-flowing selfe-mulsifying powder due to its high adsorption capacity, specific surface area (BET, in m^2/g) of 175 – 225. The optimized smedds formulation (CF9L) was adsorbed onto the surface of aerosil 200 at 0.5:1, 0.55:1, 0.65:1 (adsorbent: liquid smedds) ratio. In a porcelain dish , the different ratio of adsorbents were placed separately, the same amount of liquid smedds was added dropwise and mixed thoroughly until an uniform, homogenized powder was obtained. Then the powder was passed through sieve no. 120 and dried at ambient temperature. Then the powders were tested for angle of repose for determining their flow property.

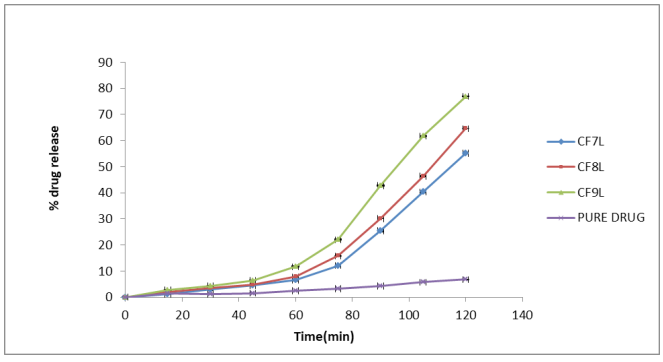

Figure 3: *In vitro* diffusion profile of stable SMEDDS formulations and pure drug (Mean ± SD; n = 3).

Flow property

The flow property of three powders was determined by calculating its angle of repose, tapped density, bulk density, hausner ratio and Carr's index. The calculated data was given in Table 4. From the flow property study, the powder having 0.65:1 (SCF9L) has good flow property.

Particle size of S-CF9L

After solidification, the particle size of S-CF9L was 205.5 and PDI 0.336. It was observed that the particle size was slightly decreased from the liquid smedds CF9L (246.5).

Drug content analysis

From the drug content analysis, S-CF9L formulation was contained 89.65%, which was more than liquid CF9L formulation because at various stages, the drug may loss.

Solid state characterization of SCF9L

Figure 4(A) represents FTIR spectra of nifedipine (pure drug) and S-CF9L. The characteristic peaks of nifedipine are 3328.70cm^{-1} (N-H stretching of amine group), 2952.90 cm^{-1} (C-H aliphatic stretching), 1677.73 cm^{-1} (C=O stretching of carboxylic group), 1622 cm^{-1} (C=C aromatic alkene stretching), 1527.07 cm-1 (NO2 stretching which were clearly observed in ftir spectra of S-CF9L. It was indicated that there was no new peak observed in SCF9L spectra. So it was confirmed that

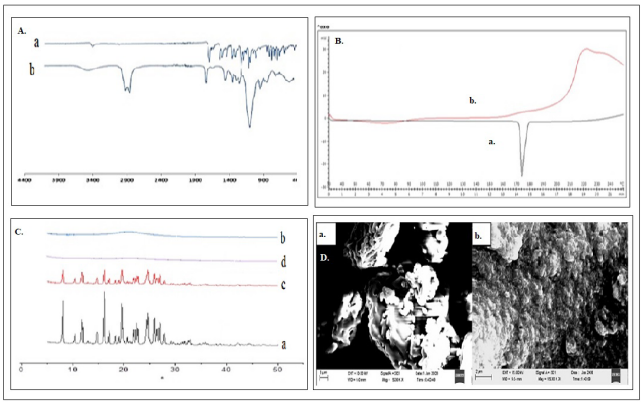

Figure 4: A. FTIR spectra of pure drug(a) and SCF9L(b), B. DSC of pure drug (a) and SCF9L(b), C. XRD study of pure drug(a), SCF9L(b), physical mixture of aerosil 200 and drug(c), aerosil 200(d) and D. SEM scan image of pure drug(a) and SCF9L(b).

Table 4: Data of micrometric evaluation of three s-smedds.

Formulation	*Bulk density(g/cm^3)*	*Tapped density (g/cm3)*	*Carr's index(%)*	*Hausner's ratio*	*Angle of repose(°)*	*Powder flow*
SCF9L(0.65:1)	0.53	0.63	15.4	1.18	22	Good
SCF9L1(0.55:1)	0.35	0.51	29.7	1.40	32	Poor
SCF9L2(0.5:1)	0.31	0.47	31.5	1.46	34	Very poor

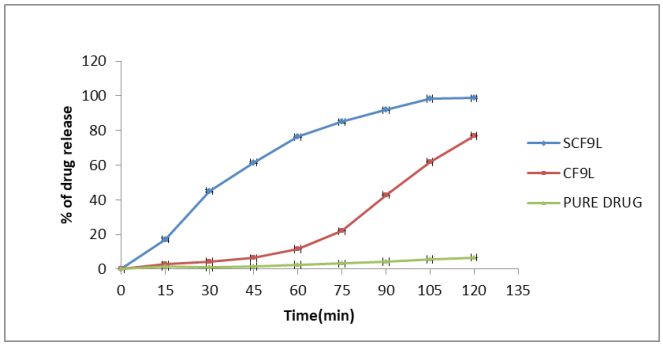

Figure 5: Represents invitro dissolution profile of solid smedds (SCF9L), smedds (CF9L) and Pure drug (nifedipine).

there was no chemical interaction between drug and excipients because of presence of important functional group.[14]

DSC thermogram of nifedipine (pure drug) and SCF9Lwas presented in Figure 4B. DSC of nifedipine shows sharp endothermic peak at 175°C, corresponding to its melting points, indicating crystalline nature of the drug. DSC of SCF9L did not show any endothermic peak corresponding to its melting point. So it was concluded that the formulation was present as amorphous or solubilized form.

The X-ray powder diffractometry (Figure 4C) of the pure drug shows some intense sharp peak, which indicated that the drug is present in crystalline state. The presence of those intense small and sharp peaks in physical mixture of drug and aerosil200 showed that the drug present in physical mixture is the semi-crystalline state. But in S-CF9L formulation, the disappearance of sharp and intense peaks indicated that the drug present in the formulation is in the amorphous state.

Figure 4D presents a SEM image of pure drug, which shows that the particles were shown as uneven shaped crystals. But the SEM image of SCF9L shows that the particle present in formulation was amorphous form and distributed uniformly throughout the surface of aerosil 200. The absence of the crystal structure proved that the aerosil 200 was a successful adsorbent which keep the drug in the amorphous state.

In vitro Dissolution Study of S-SMEDDS Preparation

Figure 5 showed the *In vitro* dissolution profile of formulation SCF9L, pure drug and liquid CF9L formulation in phosphate buffer pH 6.8 for 120 min. At 75 minutes SCF9L releases more than 80% of drug release where Liquid CF9L and pure drug release 22.01% ± 0.093 and 25% ± 0.03 respectively. At 120 min. SCF9L release drug more than 95% which was significantly higher than pure drug and CF9L ($p < 0.05$). Table 5 gives the p-value which was obtained from ANOVA analysis between solid smedds, smedds and pure drug. Drug release from SCF9L was faster due to increased surface area by use of adsorbent Aerosil 200, increasing the porosity of the formulation and may be due to transformation from crystalline to amorphous form.[6]

Table 5: Represents the observed p value between s-smedds with pure drug and liquid smedds.

Treatment pair	*p value*	*Observation*
*S vs C	0.0010053	$p < 0.05$
*S vs D	0.0010053	$p < 0.05$

CONCLUSION

Self emulsifying drug delivery system of nifedipine was successfully prepared by using castor oil as oil part, Tween 80 as surfactant, PEG 400 as co-surfactant and Aerosil 200 as adsorbent. The formulation with 10-30% of oil, 70–90% of surfactant and cosurfactant mixture was selected and evaluated for selfemulsification time, particle size, drug content, robustness to dilution test and *In vitro* dissolution study. Formulation with oil: SCOS mix (CF9L) (1:9) was adsorbed onto solid carrier aerosil 200 and converted into a free flowing powder. Then it was evaluated for particle size analysis, drug content analysis, solid state characterization and *In vitro* dissolution study. The drug content and particle size of SCF9L was 89.65% and 205.5nm respectively which gives better result than liquid CF9L. FTIR studies suggested that there was no chemical interaction between drug and excipients. DSC studies and XRD analysis indicated that the drug present in the formulation was amorphous. From the *In vitro* dissolution studies indicated that the drug release of SCF9L was significantly higher than pure drug. Thus it was concluded that solid SMEDDS formulation is capable to enhance solubility and dissolution of poorly water soluble drugs like nifedipine by using aerosil 200 which may improve therapeutic performance.

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