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Formulation and Evaluation of Simvastatin Solid Dispersions by Solvent Evaporation Method.

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ABSTRACT

Simvastatin is a BCS Class II drug having low solubility and therefore low oral bioavailability (5%). In this present study we have prepared, characterized and evaluated the solid dispersion for increasing the dissolution rate of Simvastatin. Solid dispersion of Simvastatin with various polymers was formulated by solvent evaporation technique. Solid dispersion was prepared with Kolliphor P188, Kolliwax GMS, Kolliphor ELP, HPMC AS, and Soluplus in proportions 1:1 and 1:3 besides SLS as surfactant (0 or 2%) to improving its aqueous solubility and rate of dissolution by solvent evaporation technique. All the formulations showed marked improvement in the solubility behavior and improved drug release. From all the formulations we demonstrated that the carrier Soluplus with SLS increased the aqueous solubility of Simvastatin and hence SD16 was found to be optimized formulation. The optimized formulation SD16 was characterized by Fourier transform infrared spectroscopy (FTIR), differential scanning calorimetry (DSC), and X-ray diffraction (XRD) to ascertain if there were any physicochemical interactions between drug and carrier that could affect dissolution and the change in the nature of the compound.

Keywords: Simvastatin, solid dispersions, Soluplus, X-ray diffraction.

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INTRODUCTION

Aqueous solubility of any therapeutically active substance is a key property; it governs dissolution, absorption, and thus the in vivo efficacy [1]. To improve the dissolution and bioavailability of poorly water-soluble drugs, researchers have employed various techniques such as micronization [2], solubilization [3], salt formation, complexation with polymers, change in physical form, use of prodrug and drug derivatization, pH alteration, addition of surfactants, and others [4, 5].

Oral bioavailability of a drug depends on solubility and /or dissolution rate, therefore efforts to increase dissolution of drug with limited water solubility is often needed. Improvement in the dissolution rate of the poorly soluble drudges after oral administration is one of the most crucial challenges in modern pharmaceutics. The enhancement of the bioavailability of poorly water soluble drugs is one of the greatest challenges of drug development. Amongst them is the dispersion of the drug into an inert, hydrophilic polymer matrix. There is general consensus in the pharmaceutical industry that poorly water-soluble drug candidates are becoming more prevalent [6, 7].

The term solid dispersion refers to a group of solid products consisting of at least two different components, generally a hydrophilic matrix and a hydrophobic drug. The matrix can be either crystalline or amorphous. The drug can be dispersed molecularly, in amorphous particles or in crystalline particles [8].This method is simple, economical, and advantageous. The first drug whose rate and extent of absorption was significantly enhanced using the solid dispersion technique was sulfathiazole [9].

Approximately 40-70% of new drug candidates display poor oral absorption characteristics, due to poor solubility which tends to delay in development / failure of drug approval for the oral dosage form. This creates need of developing novel and innovative oral drug delivery technologies that can successful delivery the new drugs in the future.

Simvastatin is designated as 2,2-dimethyl- ,1,2,3,7,8,8a-hexahydro-3,7-dimethyl-8-[2-(tetrahydro - 4-hydroxy-6-oxo-2*H*-pyran-2-yl)-ethyl]-1-naphthalenyl ester. Simvastatin is widely used in the treatment of dyslipidemia as an adjunct to diet. It is practically water insoluble crystalline compound (BCS Class II drug) and the dissolution is the rate-limiting step that controls its oral absorption [10, 11]. Therefore, improvement in solubility and dissolution rate is essential to enhance drug bioavailability [12]. Its biological half life and bioavailability are 3 h and 5% indicating extensive first pass metabolism in liver, respectively. It is well absorbed from GIT [13, 14]; therefore, it is vital to augment its aqueous solubility, dissolution rate and bioavailability from its oral solid formulations.

MATERIALS AND METHODS

Simvastatin was supplied by, Kolliwax GMS, Polyethylene glycol 6000 and Polyethylene glycol 4000 are from SDFCL, Mumbai. HPMC AS and Sodium starch glycolate obtained from Hetero Drug Ltd, Hyderabad, Kolliphor P188, Kolliphor EL, Kolliphor ELP, Soluplus and Kolliphor TPGS were gifted from BASF, Germany. All other chemicals and reagents used were of analytical grade.

Preliminary solubility studies of Simvastatin [15]

Solubility measurements of Simvastatin were performed according to a published method (Higuchi and Connors 1965). An excess amount of Simvastatin was added to 25ml of aqueous solution of water soluble carriers like Kolliphor EL, Kolliphor ELP, Kolliphor TPGS, Kolliphor P 188, Kolliwax GMS 2, Soluplus, HPMC AS, Sodium starch glycolate, and PEG 6000&4000 in various ratios (**Shown in the Table 2)** in screw capped bottles. Samples were shaken for the 48 hours at room temperature. Subsequently, the suspensions were filtered through a Whatman filter paper no 1. Filtered solutions were analyzed for the Simvastatin in UV 237 nm.

Preparation of solid dispersions of Simvastatin by solvent evaporation method [16, 17]

Simvastatin solid dispersions of twenty formulations were prepared by using various carriers (**Table 1&2)** (i.e. Kolliphor P188, Kolliwax GMS, Kolliphor ELP, HPMC AS, Soluplus etc.,) in proportions viz. 1:1, 1:3 (Drug: Carrier) and with or without SLS, The drug and carrier was dissolved in methanol and triturated in dry

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mortar until the solvent is evaporated and a clear film of drug and carrier was obtained. The resultant solid dispersion was scraped out with a spatula. Solid dispersions were pulverized in a mortar and pestle and passed through a 45µm sieve before packing in an airtight container

Table 1: Formulation table for the Simvastatin solid dispersions:

S. No	Ingredients (Units)	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8	SD9	SD10
1	Simvastatin (gm)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2	Kolliwax GMS (gm)	0.4	0.4	1.2	1.2	-	-	-	-	-	-
3	Kolliphor ELP (gm)	-	-	-		0.4	0.4	1.2	1.2	-	-
4	Kolliphor P 188 (gm)	-	-	-	-					0.4	0.4
6	Soluplus (gm)	-	-	-	-	-	-	-	-	-	
7	HPMC AS	-	-	-	-	-	-	-	-	-	-
8	SLS (gm)	0%	2%	0%	2%	0%	2%	0%	2%	0%	2%
9	Methanol (mL)	Qs	Qs	Qs	Qs	Qs	Qs	Qs	Qs	Qs	Qs

Table 2: Formulation table for the Simvastatin solid dispersions:

S. No	Ingredients (Units)	SD11	SD12	SD13	SD14	SD15	SD16	SD17	SD18	SD19	SD20
1	Simvastatin (gm)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2	Kolliwax GMS (gm)	-	-	-	-	-					
3	Kolliphor ELP (gm)	-	-	-	-	-					
4	Kolliphor P 188 (gm)	1.2	1.2	-	-	-					
6	Soluplus (gm)			0.4	0.4	1.2	1.2				
7	HPMC AS	-	-					0.4	0.4	1.2	1.2
8	SLS (gm)	0%	2%	0%	2%	0%	2%	0%	2%	0%	2%
9	Methanol (mL)	Qs	Qs	Qs	Qs	Qs	Qs	Qs	Qs	Qs	Qs

Solubility studies of Simvastatin solid dispersion by solvent evaporation method:

Solubility measurements of Simvastatin were performed according to a published method [16]). Samples were shaken for the 48 hours at room temperature. Subsequently, the suspensions were filtered through a Whatman filter paper no 1. Filtered solutions were analyzed for the Simvastatin in UV 237nm.

Evaluation of Simvastatin solid dispersions:

Solid dispersions obtained from the above method were tested for their Physical appearance, % Practical yield, Drug content, FTIR, DSC, SEM study and in-vitro release studies.

Physical appearance

It includes the visual inspection of solid dispersion

Percentage Practical Yield

Percentage practical yield was calculated to know about percent yield or efficiency of any method, thus its help in selection of appropriate method of production. SDs were collected and weighed to determine practical yield (PY) from the following equation (18).

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$$\% \text{ Practical Yield} = \frac{\text{Practical Mass (Solid dispersion)}}{\text{Theoretical Mass (Drug + Polymer + Surfactant)}} \times 100$$

Drug content

Solid dispersions equivalent to 40 mg of Simvastatin were weighed accurately and dissolved in 100 ml of methanol. The solution was filtered, diluted suitable and drug content was analyzed at λ_{max} 237 nm against blank by UV spectrometer. The actual drug content was calculated using the following equation as follows (19).

$$\% \text{ Drug content} = \frac{\text{Actual amount of drug in solid dispersion}}{\text{Theoretical amount of drug in solid dispersion}} \times 100$$

***In vitro* Dissolution study of solid dispersion**

The dissolution rate of Simvastatin as such and from solid dispersions prepared was studied respectively in 900 ml of phosphate buffer pH 6.8 using USP type II (paddle type) dissolution test apparatus with a paddle stirrer at 75 rpm. A temperature 37±5°C was maintained throughout the study. Drug or solid dispersion equivalent to 40 mg of Simvastatin was used in each test. Samples of dissolution media (5ml) were withdrawn through a filter (0.45µ) at different intervals of time, suitably diluted and assayed at 237nm. The samples of dissolution fluid withdrawn at each time were replaced with fresh fluid [20].

FTIR studies [21]

Instrument used was Shimadzu FTIR-8700 spectrophotometer. In this study, potassium bromide disc method was employed. Pure drug, physical mixtures, and solid dispersion studied by IR. The powdered sample was intimately mixed with dry powdered potassium bromide. The mixture was then compressed into transparent disc under high pressure using special dies. The disc was placed in IR spectrophotometer using sample holder and spectrum was recorded.

SEM (Scanning Electron microscope) studies [22]

The surface morphology of the layered sample was examined by using SEM. The small amount of powder was manually dispersed onto a carbon tab (double adhesive carbon coated tape) adhered to an aluminum stubs. These sample stubs were coated with a thin layer (30Å) of gold by employing POLARON-E 3000 sputter coater. The samples were examined by SEM and photographed under various magnifications with direct data capture of the images onto a computer.

Stability studies:

Prepared solid dispersions were placed inside the sealed 40CC HDPE container with child resistant cap under controlled temperature environment inside stability chamber (Thermo Lab, India) with relative humidity of 75%±5%RH and temperature of 40 ^{0}C±2^{0}C for stability studies. Samples were removed after 1, 2, 4 and 6 months, evaluated for % drug content and in vitro dissolution study and compared with those SD tested immediately after preparation [16].

RESULTS AND DISCUSSION

Preliminary solubility studies of Simvastatin:

In case of solid dispersions initially preliminary solubility analysis was carried out to select the appropriate water soluble carriers for the preparation of solid dispersion in which pure drug solubility was found to be 1.201µg/ml (**Table 3**). From this study, drug and Soluplus in the ratio of 1:1 shown highest drug solubility i.e. 9.17±0.02µg/ml, almost 9 fold increased compared to that of pure drug. For all the water soluble carriers used in preliminary solubility studies, PEG 6000, PEG 4000, Sodium Starch Glycolate, Kolliphor EL and

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Kolliphor TGPS shown low solubility when compared with other carriers and did not included in the preparation of Simvastatin solid dispersions. The graphical representation of solubility studies of Simvastatin physical mixtures was shown in **Figure 1**.

Table 3: Preliminary solubility studies of Simvastatin in different polymers

Physical Mixture	Solubility (µg/ml)
Pure Drug	1.201±0.04
Drug + HPMC	5.27±0.003
Drug + Soluplus	9.17±0.02
Drug + Kolliwax GMS	6.32±0.01
Drug + Kolliphor EL	5.31±0.25
Drug + PEG 6000	3.99±0.04
Drug + Kolliphor TGPS	4.51±0.05
Drug + PEG 4000	3.45±0.07
Drug + Sodium Starch Glycolate	4.02±0.11
Drug + Kolliphor P188	5.15±0.13
Drug + Kolliphor ELP	5.52±0.13

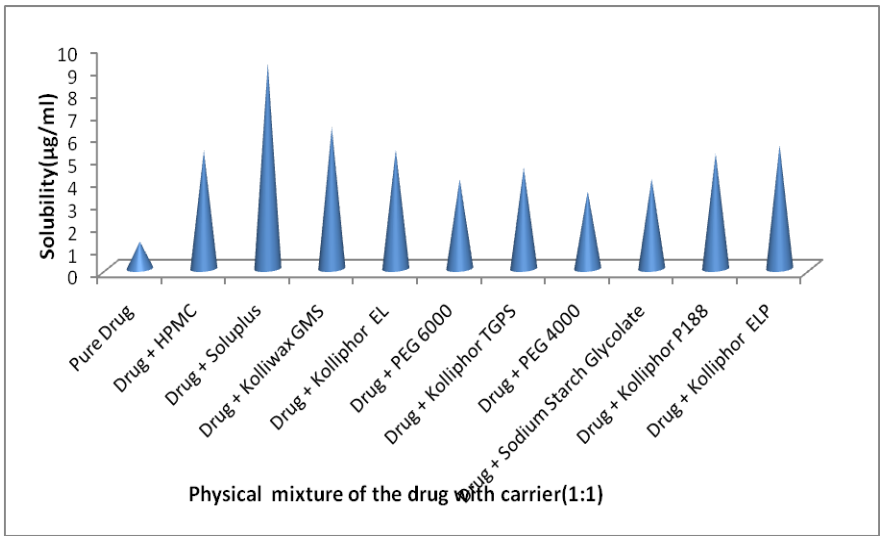

Figure 1: Solubility studies of Simvastatin physical mixture

Preparation of Simvastatin solid dispersions

Solid dispersions of Simvastatin were prepared by using Kolliphor P188, Kolliwax GMS, HPMC, Kolliphor ELP and Soluplus in two different drug-polymer ratios (1:1 and 1:3) besides SLS as surfactant (0 or 2%) are weighed and mixed together in a porcelain dish. Twenty different formulae were prepared by the solvent evaporation method. The mixture was dissolved in the least amount of Methanol as a common solvent. Then the solvent was evaporated in oven at temperature 50ºC till complete evaporation. The resultant solid dispersion was scraped out with a spatula. Solid dispersions were pulverized in a mortar and pestle and passed through a 45µm sieve before packing in an airtight container, stored in desiccators and used for further investigations. In the present investigation 20 formulations were prepared and their complete composition was shown in **Table 1&2.** All the solid dispersions prepared were found to be fine and free flowing powers.

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Figure 2: Simvastatin Solid dispersions

Evaluation parameters:

Solubility studies of Simvastatin solid dispersions:

Different formulations of Simvastatin solid dispersions were prepared by solvent evaporation method with their respective carriers. After preparation of solid dispersion solubility analysis was carried out. The formulation (SD16) with Soluplus in the ratio of 1:3 and with SLS shown highest solubility i.e. 20.09±0.02µg**/**ml, almost 20 fold compared to that of the pure drug (Pure drug solubility is 1.201±0.04 µg/ml). The results are tabulated in **Table 4** and graphical representation was shown in **Figure 3**.

Table 4: Solubility studies of Simvastatin solid dispersions prepared by solvent evaporation method:

S. No.	Formulation code	Solubility (µg /ml)*
1	Pure drug (c)	1.201±0.04
2	SD1	10.26±0.02
3	SD2	11.32±0.03
4	SD3	13.12±0.02
5	SD4	14.63±0.04
6	SD5	8.27±0.03
7	SD6	10.56±0.04
8	SD7	11.56±0.01
9	SD8	12.44±0.03
10	SD9	4.99±0.07
11	SD10	6.67±0.13
12	SD11	7.98±0.22
13	SD12	9.77±0.08
14	SD13	14.26±0.02
15	SD14	17.56±0.03
16	SD15	18.42±0.02
17	SD16	20.09±0.02
18	SD17	6.26±0.04
19	SD18	8.16±0.03
20	SD19	9.76±0.04
21	SD20	12.56±0.07

***Mean**±SD, n=5

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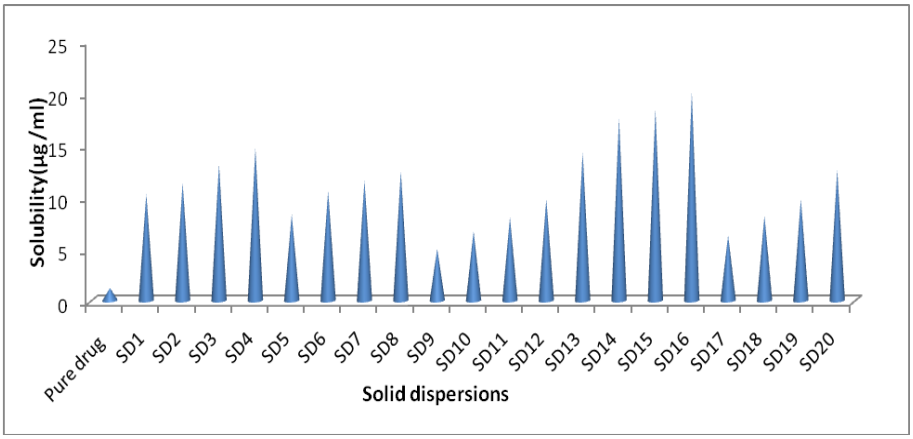

Figure 3: Solubility studies of Simvastatin solid dispersion

% Practical yield and drug content:

The results of % practical yield for all formulations of solid dispersions found to be 83.22% - 99.08%. The results of % practical yield studies are shown in **Table 5.** Maximum yield was found to be 99.08% in formulation SD16. Actual drug content of all 20 formulations are shown in **Table 4**. The drug content of the prepared solid dispersions was found to be in the range of 82.91 – 99.12%. Maximum % drug content i.e. 99.12% was found in the formulation SD16.

Table 5: % Practical yield and drug content for Simvastatin solid dispersions

S. No	Formulation	% Practical Yield	% Drug content
1	SD1	91.47	95.21
2	SD2	94.77	92.46
3	SD3	87.62	93.68
4	SD4	91.13	93.03
5	SD5	96.55	92.47
6	SD6	91.68	94.92
7	SD7	91.98	93.50
8	SD8	96.22	94.52
9	SD9	91.87	82.91
10	SD10	94.26	92.56
11	SD11	91.99	94.57
12	SD12	83.22	91.64
13	SD13	91.87	92.43
14	SD14	93.27	89.37
15	SD15	94.26	92.52
16	SD16	99.08	99.12
17	SD17	89.23	91.01
18	SD18	85.23	90.99
19	SD19	86.33	93.88
20	SD20	84.88	90.35

In vitro dissolution studies

The drug release data obtained for formulations SD1-SD20 are tabulated in **Tables 6, 7 & 8.** It shows the cumulative percent drug released as a function of time for all formulations. The cumulative percent drug released after 90 min was shown in table.

In vitro studies reveal that there is marked increase in the dissolution rate of Simvastatin from all the solid dispersions when compared to pure Simvastatin itself. From the in vitro drug release profile, it can be seen that formulation SD16 containing Soluplus (1:3 ratio of drug: Soluplus with surfactant) shows higher dissolution rate i.e. 99.2±2.9 % compared with other formulations.

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This may be attributed to the increase in drug wettability, conversion to amorphous form and solubilization of the drug due to hydrophilic carrier. The graphical representation of solid dispersions of SD1-SD8, SD9-SD14& SD15-SD20 with pure drug was depicted in **Figures 4, 5 & 6**.

Table 6: In vitro dissolution profile of pure drug and different formulations of Simvastatin solid dispersions (SD1-SD8)

Time in Min	Cumulative % drug release								
	Pure drug	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
0	0	0	0	0	0	0	0	0	0
5	8.35 ±0.43	20.6±2.9	24.6±2.9	26.8±2.0	30.3±2.5	21.4±3.7	23.6±2.9	26.6±2.9	29.6±2.9
10	14.18±0.12	31.7±3.9	33.7±3.9	34.3±2.9	36.9±1.5	31.9±1.9	35.7±3.9	37.7±3.9	39.5±3.9
20	19.10±0.36	39.8±2.0	42.8±2.0	45.5±3.3	49.5±2.7	44.1±2.8	49.8±2.0	55.8±2.0	60.5±2.0
30	21.90±0.73	53.4±1.4	56.4±1.4	58.5±3.8	60.2±2.6	53.4±1.4	62.4±1.4	65.4±1.4	66.4±1.4
45	29.09±0.40	62.7±3.8	65.7±3.8	68.5±1.9	72.5±2.2	67.5±2.7	71.7±3.8	76.7±3.8	78.7±3.8
60	32.93 0.80	71.4±2.2	75.4±2.2	76.9±3.3	81.3±2.9	75.3±2.9	81.4±2.2	84.4±2.2	85.4±2.2
90	38.95±0.64	84.6±1.7	86.6±1.7	88.4±3.1	90.5±2.8	82.4±3.8	84.6±1.7	86.6±1.7	88.6±1.7

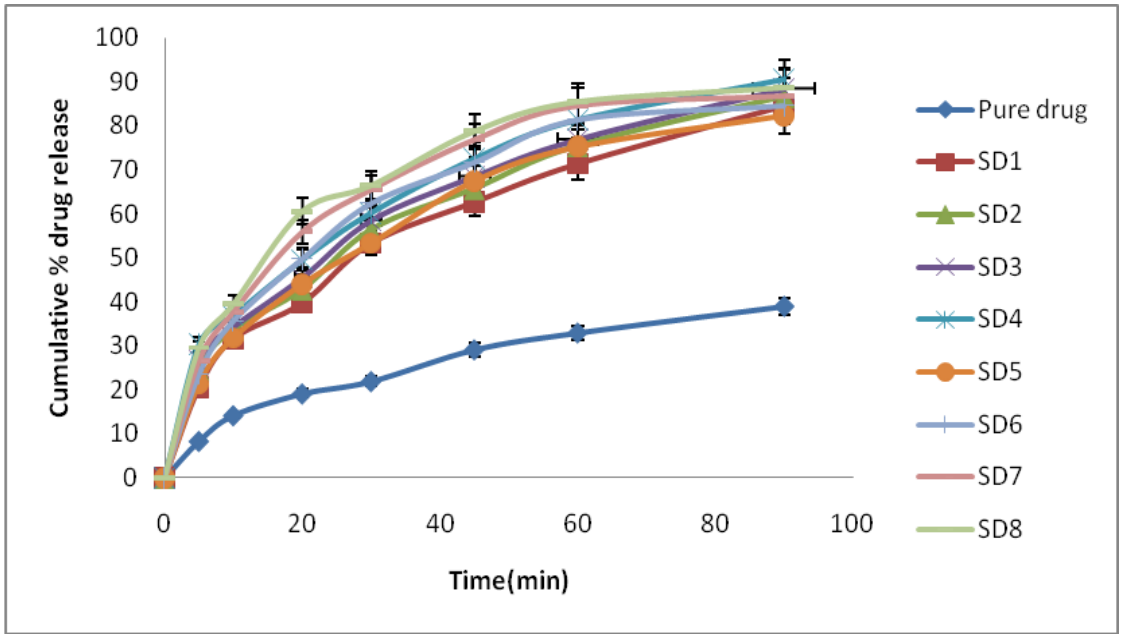

Figure 4: In vitro dissolution profile of pure drug and different formulations of Simvastatin solid dispersions (SD1-SD8)

Table 7: In vitro dissolution profile of pure drug and different formulations of Simvastatin solid dispersions (SD9-SD14)

Time in Min	Cumulative % drug release					
	SD9	SD10	SD11	SD12	SD13	SD14
0	0	0	0	0	0	0
5	28.2±2.9	29.1±1.9	31.1±1.9	33.1±1.9	26.6±2.9	23.4±2.9
10	36.8±3.0	35.6±2.5	37.6±2.5	39.6±2.5	36.7±3.9	28.8±2.3
20	48.2±2.6	47.8±2.7	47.8±2.7	51.8±2.7	58.8±2.0	31.5±1.6
30	58.4±2.3	58.2±2.4	59.2±2.4	62.2±2.4	63.4±1.4	32.8±1.8
45	66.2±2.8	65.6±3.4	68.6±3.4	71.6±3.4	77.7±3.8	37.5±1.7
60	75.2±2.4	78.2±2.0	79.2±2.0	81.2±2.0	84.4±2.2	41.9±1.8
90	80.2±2.8	84.2±2.2	86.2±2.2	89.2±2.2	90.6±1.7	91.2±1.2

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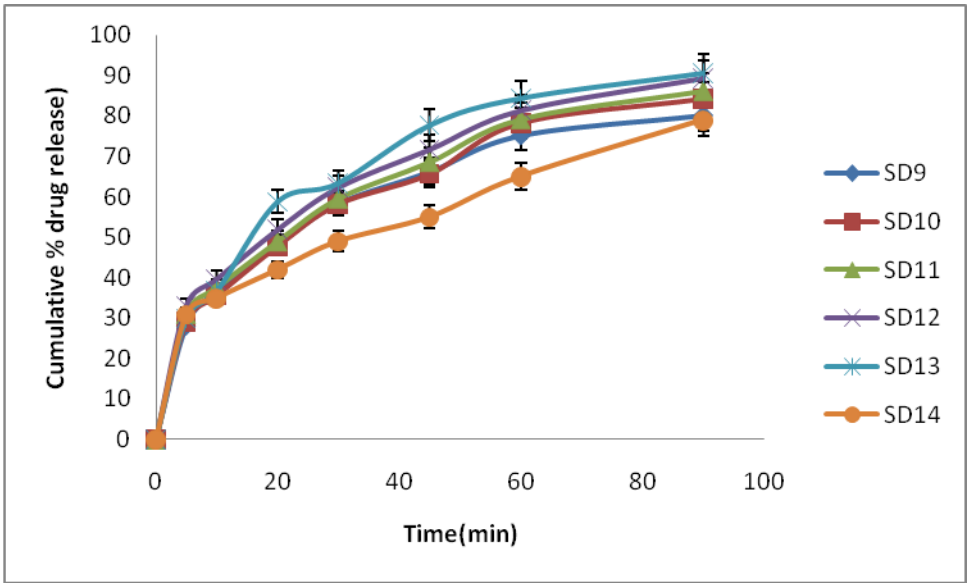

Figure 5: In vitro dissolution profile of pure drug and different formulations of Simvastatin solid dispersions (SD9-SD14)

Table 8: In vitro dissolution profile of pure drug and different formulations of Simvastatin solid dispersions (SD15-SD20)

Time in Min	Cumulative % drug release					
	SD15	SD16	SD17	SD18	SD19	SD20
0	0	0	0	0	0	0
5	21.5±1.3	40.1±2.3	26.8±2.0	30.3±2.5	31.3±2.5	33.3±2.5
10	31.0±2.4	59.2±2.8	30.3±2.9	36.9±1.5	38.9±1.5	41.9±1.5
20	32.5±3.3	68.5±2.2	46.5±3.3	46.5±2.7	47.5±2.7	50.5±2.7
30	33.1±2.6	77.2±2.3	59.5±3.8	58.2±2.6	59.2±2.6	59.2±2.6
45	36.0±2.4	89.4±3.0	64.5±1.9	64.5±2.2	65.5±2.2	68.5±2.2
60	41.2±4.3	96.6±1.6	70.9±3.3	77.3±2.9	79.3±2.9	81.3±2.9
90	94.8±3.4	99.2±2.9	72.4±3.1	79.5±2.8	80.5±2.3	83.5±2.5

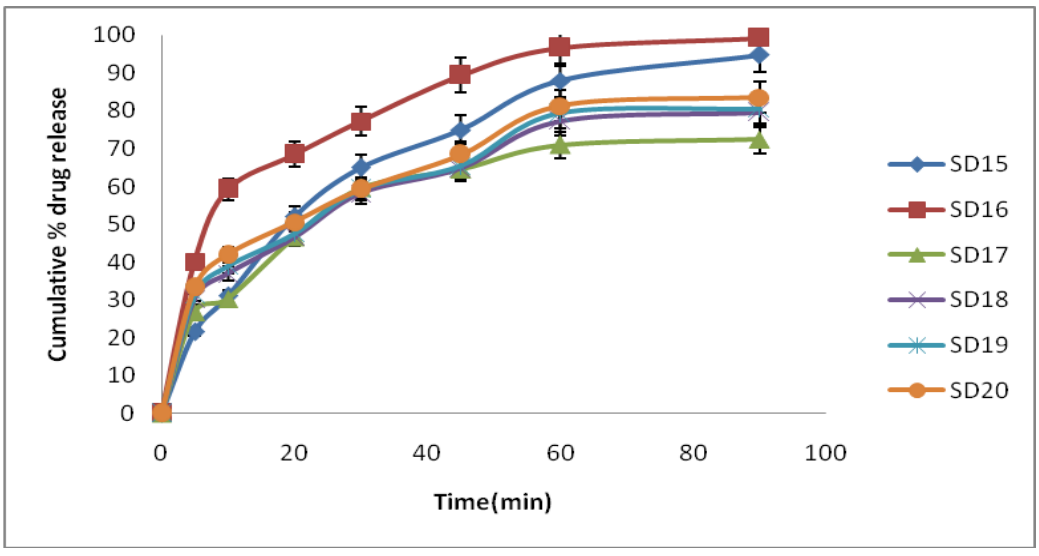

Figure 6: In vitro dissolution profile of pure drug and different formulations of Simvastatin solid dispersions (SD15-SD20)

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Stability studies:

Optimized formulation (SD16) was selected for stability studies on the basis of high cumulative % drug release. Stability studies were conducted for 6 months at Accelerated stability conditions according to ICH guidelines. To evaluate the physical state of the drug, the systems were evaluated for drug content, In vitro drug release profile and characterized by XRD after storage for 6 months. The systems were stable during a 6-month period. From these results it was concluded that, optimized formulation (SD16) is stable and retained their original properties with minor differences which depicted in **Table 9.**

Table 9: Evaluation parameters of optimized formulation (SD16) stored at 40 ±2^{0}c /75 ±5%rh

Retest time for optimized formulation	% Drug content	*In-vitro* drug release (%)
0 days	99.12	99.22
30 days	98.01	97.45
60 days	96.75	96.51
120 days	94.05	95.35
180 days	93.52	94.05

FTIR studies:

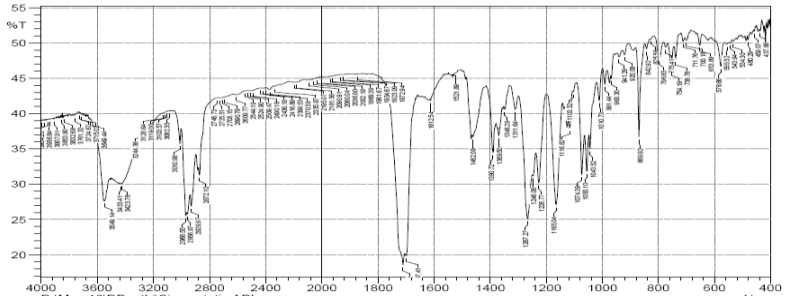

Figure 6: FTIR Spectrum of Simvastatin pure drug

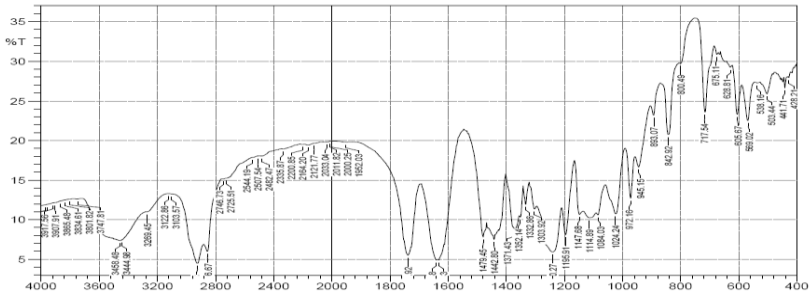

Figure 7: FTIR Spectrum of Soluplus

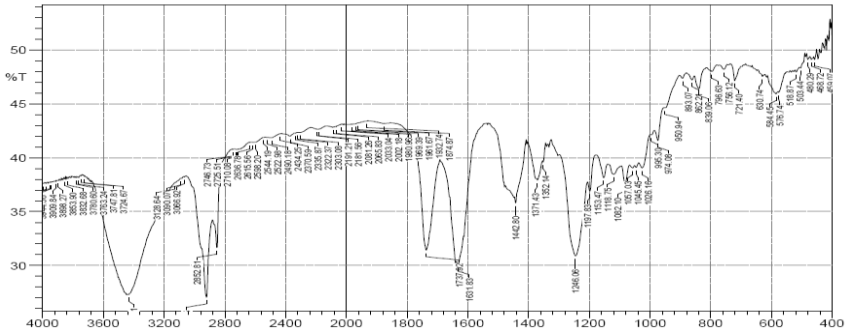

Figure 8: FTIR Spectrum of Simvastatin optimized formulation (SD16)

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Infrared spectra of Simvastatin & containing soluplus and SLS are presented in **Figure 8.** Simvastatin pure drug shows major peaks at 1266.95, 1164.49, 2923.50 & 1796 cm^{-1} assigned to –OH bending alcohol, C-O stretching ketone respectively & almost the similar bands are observed & identified in the spectrum of the formulation is shown in **Figure 6, 7**. Hence the study indicates that there was no drug-polymer interaction.

X-Ray Diffraction patterns:

The Simvastatin solid dispersions were analyzed in Bruker D8 advanced PXRD instrument to find out whether the solid dispersions of various drug polymer ratios are crystalline or amorphous. The presence of numerous distinct peaks in the XRD spectrum of pure Simvastatin indicates that Simvastatin was present as a crystalline material (**Figure 10**). On the other hand, the spectrum of optimized formulation SD16 of solid dispersion was characterized by the complete absence of any diffraction peak, which is characteristic of an amorphous compound (**Figure 11**). The enhancement in the dissolution rate of the drug from the drug-soluplus-SLS solid dispersion is ascribed to the marked reduction in the crystallinity of the drug.

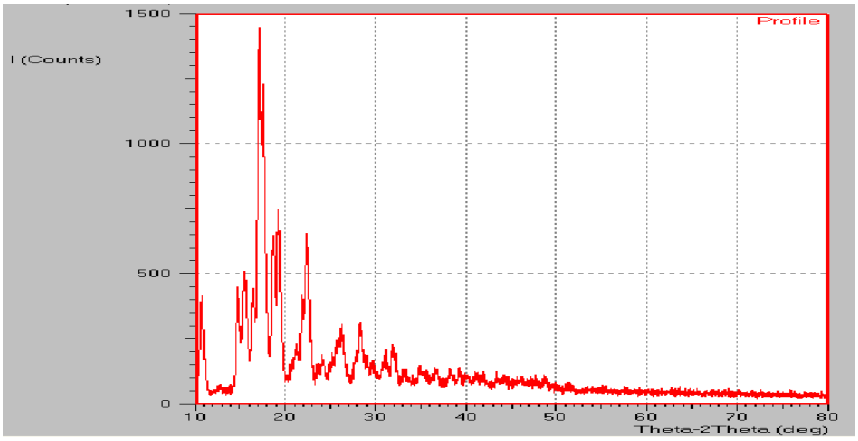

Figure 10: X-Ray powder diffractogram of Simvastatin pure drug

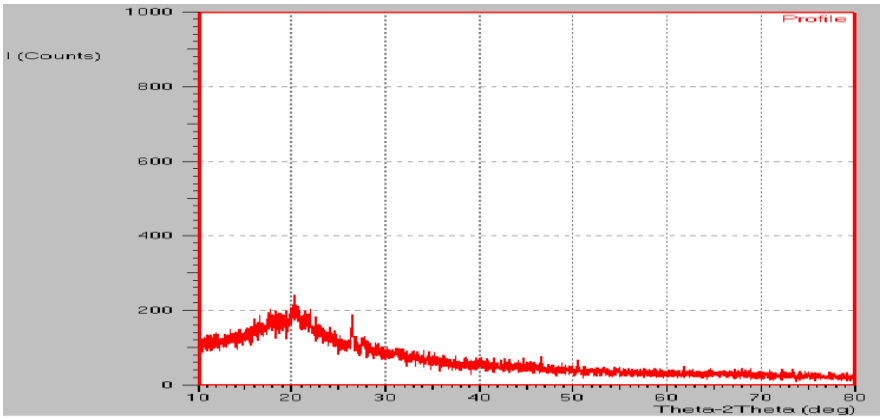

Figure 11: X-Ray powder diffractogram of Simvastatin optimized formulation (SD 16)

SEM Studies:

SEM photographs for pure drug and optimized formulation SD16 are shown in **Figure 12** the drug crystals seemed to be smooth-surfaced, irregular in shape and size. In case of Solid dispersions, it was difficult to distinguish the presence of drug crystals. The drug surface in solid dispersion seems to be more porous in nature. Solid dispersions appeared as uniform and homogeneously mixed mass with wrinkled surface. Drug crystals appeared to be incorporated into the particles of the polymers. The solid dispersion looked like a matrix particle. The results could be attributed to dispersion of the drug in the molten mass of the polymer.

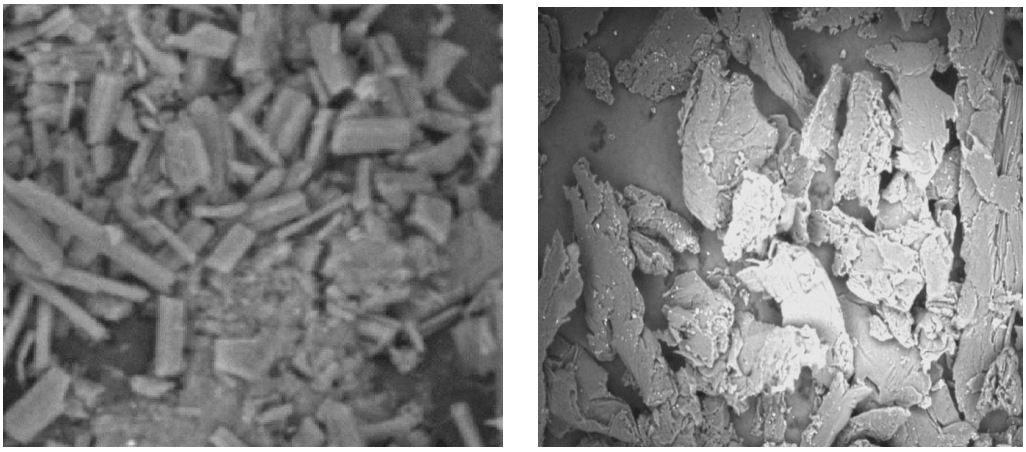

Figure 12: Pure drug of Simvastatin and Simvastatin optimized formulation (SD16)

CONCLUSION

In the present study it was clearly demonstrated that solid dispersion formulation can be effectively produced by processing via solvent evaporation method with enhanced solubility and dissolution rate. Novel polymer–surfactant combinations were optimized and stable SD systems were developed successfully. Solid dispersion preliminary solubility analysis was carried out for the selection of carriers and solid dispersion was prepared with Kolliphor EL, Kolliphor ELP, Kolliphor TPGS, Kolliphor P 188, Kolliwax GMS 2, Soluplus, HPMC AS, Sodium starch glycolate, and PEG 6000&4000 .Utilization of Soluplus along with suitable surfactants offers excellent possibilities to develop stable amorphous solid dispersion.

Drug content analysis and in vitro dissolution study of Soluplus is most preferably used for solubility and dissolution enhancement than other polymers. FT-IR studies shows there was no degradation of drug. The solubility and dissolution studies showed there is a possibility of improved solubility of Simvastatin through solid dispersion with Soluplus.

Analysis of X-ray diffraction showed that Simvastatin existed in the amorphous form within the solid dispersion formulation fabricated using the solvent evaporation process. Additionally, scanning electron microscopy studies suggested the conversion of crystalline Simvastatin to an amorphous form. Finally it could be concluded that solid dispersion of Simvastatin using novel carriers would improved the aqueous solubility, dissolution rate and thereby enhancing its systemic availability.

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