Innovations in Pharmaceuticals and Pharmacotherapy

www.innpharmacotherapy.com

eISSN: 2321–323X
pISSN: 2395-0781

Research article

Strategy to enhance solubility and dissolution of atorvastatin calcium by solid dispersion using super disintegrants

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Abstract

Atorvastatin calcium (AST) is an anticholestermic agent characterize by low solubility and high permeability which corresponds to BCS class II drug. The purpose of this study was to improve the solubility and dissolution rate of poorly water soluble drug AST by solid dispersion technique using super diintegrants such as Sodium starch glycolate (SSG) and Crospovidone (CPD). Method: The solid dispersion of AST by physical mixing and solvent evaporation method were prepared using 1:1,1:3,1:5 and 1:7 ratio of drug to super disintegrants. Result: Solid dispersion were evaluated for Drug Content, Saturation solubility studies, Dissolution rate studies, Fourier Transform Infrared spectroscopy (FTIR) and Differential Scanning Calorimetry (DSC). The results of FTIR demonstrate no detectable interaction between drug and super disintegrant and DSC analysis showed that sharp melting point was completely disappeared suggesting that the AST molecularly dispersed in amorphous in form. Conclusion: From solubility and dissolution data that it may concluded that through a solid dispersion prepared by solvent evaporation method in ratio 1:7 shows enhancement in solubility and dissolution but solid dispersion of drug with SSG in ratio 1:7 w/w shows better solubility and dissolution enhancement and solubility was increased almost 4 folds from this dispersion. Tablets were formulated containing optimised solid dispersion and compared with marketed tablet.

Keywords: BSC class II, solid dispersion, solvent evaporation, atorvastatin calcium, super disintegrants.

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1. Introduction

Poor aqueous solubility of drugs is major limiting factor with many new drugs in their successful launch in market inspite of their potential pharmacokinetic activity. About 90% of all compounds in today's pharmaceutical drug delivery pipelines are reported to be poorly soluble in water. This process enormous problem for the industry; for an active pharmaceutical ingredients cannot reach it's molecular target in the body if the drug remains undissolved in the gastrointestinal tract [GIT] and is eventually excreted. The massage simple: drugs that don't dissolve will not heal you. Therefore poor solubility is critical factor if the molecule is to survive the pharmaceutical development process. Even those; molecule that would have highly beneficial effect on their physiological target would not be further developed if their bioavailability is limited by their solubility in water. Further poorly water soluble drugs are generally administered at much higher dose than the actual dose in order to achieve necessary drug plasma level leading to improved adverse reaction and cost of therapy and often yields erratic pharmacological response and hence poor

patient complains. In addition, the manufacturing cost would increase since a large amount of active pharmaceutical ingredient (API) might be consumed to develop and manufacture the drug product [1, 2].

Thus solubilisation technologies that overcome this issue by increasing the solubility of such drug candidates are becoming more and more important to the pharmaceutical industry by opening up pathway to prepare effective and marketable drugs from active that would otherwise useless [3]. Atorvastatin calcium is a member of the drug class known as statins. It is used for lowering cholesterol. Atorvastatin is a competitive inhibitor of hydroxymethylglutaryl-coenzyme A (HMG-CoA) reductase, the rate-determining enzyme in cholesterol biosynthesis via the mevalonate pathway. HMG-CoA reductase catalyzes the conversion of HMG-CoA to mevalonate. Atorvastatin acts primarily in the liver [4]. Decreased hepatic cholesterol levels increases hepatic uptake of cholesterol and reduces plasma cholesterol levels. Statins are the most commonly prescribed lipid-lowering agents because they are effective, well tolerated and easy to administer. They are generally effective, are supported by favorable outcome studies and have relatively few by favorable outcome studies and have relatively few adverse effects. The six statins currently available are atorvastatin (Lipitor), cerivastatin (Baycol), fluvastatin (Lescol), lovastatin (Mevacor), pravastatin (Pravachol) and simvastatin (Zocor) [5].

The term solid dispersion refers to the dispersion of one or more active ingredients in an inert carrier or matrix in solid state prepared by melting (fusion), solvent, or melting solvent method. Solid dispersions (SDs) have traditionally been used as an effective method to improve the dissolution properties and bioavailability of poorly water-soluble drugs (Chiou and Riegalman, 1971; Serajuddin, 1999; Leuner and Dressman, 2000) [6]. In solid dispersion systems, a drug may exist as an amorphous form in polymeric carriers, and this may result in improved solubilities and dissolution rates as compared with crystalline material. The mechanisms for the enhancement of the dissolution rate of solid dispersions have been proposed by several investigators. Drugs molecularly dispersed in polymeric carriers may achieve the highest levels of particle size reduction and surface area enhancement, which result in improved dissolution rates. Furthermore, no energy is required to break up the crystal lattice of a drug during dissolution process and drug solubility and wettability may be increased by surrounding hydrophilic carriers [7, 8].

Atorvastation calcium in an anticholesteremic agent falling in pyrimidine based ring with fluorophenyl group category, which is used for Inhibitions of HMG-CoA reductase. The drug is poorly water soluble with solubility 2-2.3µg/ml in water [9]. Hence a need was seen to improve solubility and in turns dissolution of the Atorvastatin. To improve solubility and dissolution solid dispersion with various polymer such as sodium starch glycolate and crospovidone were proposed [10].

2. Material and method

The drug Atorvastatin calcium was procured as gift sample from Concept pharma Aurangabad India. CPD and SSG was purchased from Arvind Chemicals, Solapur, India.

All other chemical and reagent used were of analytical reagent grade.

UV Spectroscopic Method of Analysis [11]

Determination of λ_{max}: Solutions of 4 µg/ml to 24 µg/ml of atorvastatin were prepared in methanol and scanned between 200-400 nm using Shimadzu UV-1800 spectrophotometer showed maximum constant absorbance at wavelengths 246.6 nm.

Calibration Curve of Atorvastatin in Methanol

50 mg Atorvastatin was accurately weighed and dissolved in small volume of methanol, then transferred to 50 ml volumetric flask. The volume was made up to 50 ml with methanol and sonicated for 5 min. From this solution, 1 ml was diluted again with methanol up to 10 ml (100 µg/ml). The resulting solution was considered as stock solution and further solutions of strengths 4, 8, 12, 16, 20, 24 µg/ml were made from this stock solution by appropriate dilutions. The above solutions were analyzed by UV spectrophotometer at λ_{max} 246.6 nm. Methanol was used as blank during spectrophotometric analysis*.*

Preparation of solid dispersion

Preparation of physical mixture

Physical mixtures of Atorvastatin with SSG and CPD containing four different weight ratios (1:1,1:3,1:5,1:7) w/w were prepared separately as follows [12].

AST and SSG and CPD were accurately weighed, pulverized and then mixed thoroughly by light triturated for 5 min in a mortar until homogenous mixture was obtained. The mixture was passed through a #72 sieve. The physical mixtures were made in different ratios with respect to drug and polymers as shown below in (Table 1**).**

Preparation of solid dispersion by solvent evaporation method

Solid dispersions of Atorvastatin with superdisintegrants SSG and CPD were used simultaneously as procedure afforded below [13, 14].

The required quantities of Atorvastatin were dissolved in methanol to get a 20mg/ml solution in a dry beaker. Similarly, superdisintegrant were suspended in sufficient amount of distilled water (up to wet mass of polymer). The drug solutions were poured at once into polymer suspension. The above prepared mixture was then placed under constant mechanical stirring (300rpm) for 90 min. The mass obtained was further dried at 50^0 C for 5-6 hours in an oven.

Table 1: Composition of physical mixture

S N	Composition	Formulation Code	Ratio (w/w)
1	Atorvastatin: Sodium Starch Glycolate	PSSG1	1:1
2	Atorvastatin: Sodium Starch Glycolate	PSSG3	1:3
3	Atorvastatin: Sodium Starch Glycolate	PSSG5	1:5
4	Atorvastatin: Sodium Starch Glycolate	PSSG7	1:7
5	Atorvastatin: Crosspovidone	PCPD1	1:1
6	Atorvastatin: Crosspovidone	PCPD3	1:3
7	Atorvastatin: Crosspovidone	PCPD5	1:5
8	Atorvastatin: Crosspovidone	PCPD7	1:7

The product was crushed, pulverized and shifted through a #72 sieve to obtain a uniform particle size, then transferred to glass vial and stored in desiccator at room temperature until further use. The dispersions were made in different ratios with respect to drug and polymers as shown below in (Table 2).

Evaluation of solid dispersion

Saturation solubility studies

Saturation solubility studies were carried out for pure drug, all physical mixtures and solid dispersions. This study was the basic criteria to identify and judge a solid dispersion of choice, which would enhance the solubility and so, would show good results in *in-vitro* dissolution studies [12, 14].

Table 2: Composition of solid dispersion.

SN	Composition	Formulation Code	Ratio (w/w)
1	Atorvastatin: Sodium Starch Glycolate	ASSG1	1:1
2	Atorvastatin: Sodium Starch Glycolate	ASSG3	1:3
3	Atorvastatin: Sodium Starch Glycolate	ASSG5	1:5
4	Atorvastatin: Sodium Starch Glycolate	ASSG7	1:7
5	Atorvastatin: Crosspovidone	ACPD1	1:1
6	Atorvastatin: Crosspovidone	ACPD3	1:3
7	Atorvastatin: Crosspovidone	ACPD5	1:5
8	Atorvastatin: Crosspovidone	ACPD7	1:7

To perform this study a known excess of the drug (20 mg) alone and the drug equivalent of solid dispersion and physical was accurately weighed and transferred to screw-capped glass vial containing 10 ml of distilled water. The glass vial were placed in an ultra sonicator for 4 hrs, then kept for 24 hours at room temperature. At the end of this period each solution was withdrawn and filtered through a 0.45 μm whatman filter paper and filtrate was collected into dry containers. The solution were suitably diluted with distilled water and assayed for Atorvastatin content. The assay of Atorvastatin was determined spectrophotometrically at 246.6 nm, a wavelength at which SSG and CPD does not interfere.

Similar procedure was carried out for saturation solubility in phosphate buffer pH 6.8.

Drug content

About 10 mg drug equivalent of solid dispersions (theoretical) were weighed accurately and transferred to 10 ml volumetric flask to which 5 ml methanol was added and sonicated for 5 min. Final volume was made up with methanol. From this stock solution (1000 µg/ml), 1 ml was withdrawn and diluted up to 10 ml (100 µg/ml) with methanol. 1 ml of this solution was further diluted up to 10 ml (10 µg/ml) with methanol. This solution was used for the assay for drug content by UV spectrophotometer at 246.6 nm [5]. Concentration of drug in stock solution was calculated by using calibration curve and from which percent drug content in solid dispersions was calculated,

$$\textbf{\% Drug Content} = W_A/W_T \times 100$$

W_A: actual drug content; W_T: theoretical drug content

Dissolution rate studies [9]

In-vitro dissolution studies of atorvastatin, physical mixtures (PM) and solid dispersions (SD) prepared by solvent evaporation method in weight ratios (1:1,1:3,1:5,1:7) were evaluated.

Before forming dissolution the formulation were filled in muslin cloth pouch of size 2 x 3 cm^2 [15, 16].

Following conditions were followed to study the *in-vitro* dissolution of Atorvastatin.

USP dissolution apparatus :Type-II (Paddle method)

Dissolution medium :Distilled water and phosphate buffer pH 6.8

Volume of dissolution fluid : 900 ml.

Temperature : $37 \pm 0.5\ ^0C$.

Speed : 75 rpm

Sample size : Equivalent to 20 mg of Atorvastatin

Limits to pass the dissolution test: Within 30 minutes, the release of atorvastatin should not be less than 70%.

Sample of 5 ml, was withdrawn at different time intervals of 5, 10, 15, 20, 30 minutes. The volume withdrawn was replaced by fresh volume of dissolution medium to maintain constant volume of medium. The filtered samples were analyzed spectrophotometrically at 246.6 nm. The amount of drug released was determined using respective calibration curves (Dissolution software PCP).

Infrared spectroscopy

Fourier transform infrared (FTIR) spectroscopy was employed to characterize further the possible interactions between the drug and the carrier in the solid state on a FTIR spectrophotometer by the conventional KBr pellet method. The spectra were scanned over a frequency range 4000-400 cm^{-1} with a resolution of 4 cm^{-1}.

Differential Scanning Calorimetry (DSC)

DSC analysis was performed using Shimadzu-Thermal Analyzer DSC 60 (Kyoto, Japan) on 1- to 5-mg samples. Samples were heated in an open aluminium pan at a rate of 10°C/min conducted over a temperature range of 30 to 350°C under a nitrogen flow of 50 ml/min.

Preparation of tablets of solid dispersion [17]

Based on Saturation solubility data, the optimized solid dispersions were formulated into tablets. Tablets were prepared by direct compression as per the composition as shown in (Table 3). All ingredients were sieved through mesh #72.

Table 3: Formulation of tablets

Ingredients	Quantity per Tablet (mg)	Category
Solid dispersion of ASSG7	84.86	HMG-CoA Reductase Inhibitors
Avicel pH102 (MCC)	89	Diluent
Croscarmilose sodium	40	Superdisintegrant
Magnesium stearate	1	Lubricant
Total Weight	214.86	

Each tablet of TSSG7 contains solid dispersions (ASSG7) ≈ to 10 mg of Atorvastatin and magnesium stearate amount kept constant. Basedon the saturation solubility results the above three drug carrier combinations were selected as optimized formulations.

All the above formulations were prepared by simply blending the ingredients in a geometrical fashion in a polybag.

3. Results and discussion

UV Spectroscopic method of analysis

Determination of λ_{max}

However, keeping in mind the probable concentrations likely to be encountered while carrying out saturation solubility and dissolution studies and considering the predicted dilutions involved, the working λ_{max} was decided upon as 246.6 nm.

Calibration curve of atorvastatin calcium in methanol

Calibration curve of atorvastatin was performed in pure methanol. Addition of even small quantities of water to the methanolic solution of drug turned the solution turbid. Methanolic solution of drug was very clear and readily analyzed by UV spectrophotometer. The calibration curve (Figure 1) was found to be linear in the concentration range of 4-24 µg/ml having coefficient of regression value R^2=0.999 and Slope, y=18.86.

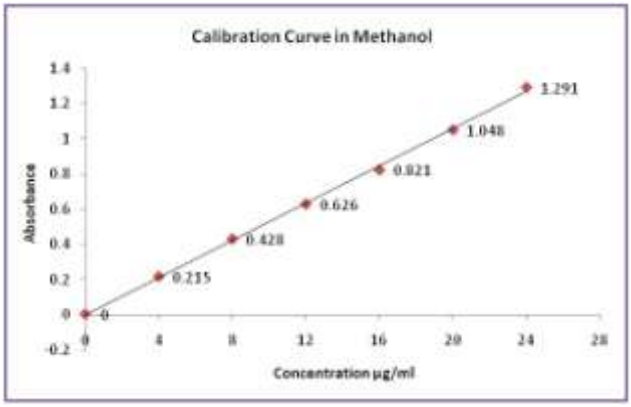

Figure 1: Calibration curve of atorvastatin in methanol

Saturation solubility studies [18]

To evaluate the effect on solubility of Atorvastatin after preparation of their solid dispersions using different carriers by solvent evaporation method, saturation solubility's of drug, physical mixtures and solid dispersions were performed in distilled water and phosphate buffer pH 6.8. The results for saturation solubility of atorvastatin and all its carrier combinations are shown in Table 4.

Drug content in physical mixtures and solid dispersions [19, 20]

The solid dispersions or physical mixtures equivalent to 10 mg of atorvastatin were used to determined drug content. The drug content in all the tested combinations was found to be in the range of 89 to 101%. The drug content of solid dispersions is shown in (Table 4).

Table 4: Saturation solubility data and percent drug content for AST in physical mixture and solid dispersions.

SN	Formulation code	Solubility of Atorvastatin (mg/ml)		Drug content %
		Distilled water	Phosphate buffer pH 6.8	
0	Pure Drug	0.185	0.201	-
1	PSSG1	0.351	0.395	98.88 ± 0.05
2	PSSG3	0.420	0.436	96.65 ± 0.08
3	PSSG5	0.449	0.544	97.92 ± 0.04
4	PSSG7	0.465	0.552	98.22 ± 0.03
5	PCPD1	0.205	0.260	99.5 ± 0.08
6	PCPD3	0.295	0.263	98.4 ± 0.04
7	PCPD5	0.297	0.300	96.1 ± 0.07
8	PCPD7	0.310	0.321	97.8 ± 0.05
9	ASSG1	0.545	0.636	98.58 ± 0.07
10	ASSG3	0.562	0.820	97.65 ± 0.07
11	ASSG5	0.759	0.910	96.82 ± 0.07
12	ASSG7	0.804	0.981	94.72 ± 0.05
13	ACPD1	0.334	0.357	95.5 ± 0.08
14	ACPD3	0.353	0.380	94.8 ± 0.04
15	ACPD5	0.367	0.404	91.5 ± 0.07
16	ACPD7	0.435	0.521	89.8 ± 0.05

Dissolution study on solid dispersion

Since atorvastatin solid dispersion were prepared by solvent evaporation method with different composition of SSG and CPD. Drug release studies of solid dispersion of drug with various carriers in various ratio done using USP dissolution apparatus type II.The results of drug release from the solid dispersion in distilled water are shown in (Figure 2, 3 & 4) and (Table 5) respectively. While the result of the drug release in phosphate buffer pH 6.8 are shownin (Figure 2, 5 & 6) and (Table 6) respectively.

From the result obtained, it can be seen that in phosphate buffer pH 6.8 with atorvastatin and SSG solid dispersion ratio (1:7), the percentage release was 76.81% up to 30 minutes, while atorvastatin CPD solid dispersion (1:7), the percentage release was found 64.10% up to 30 minutes as compared to very low dissolution of pure drug i.e. 28.05% release up to 30 minutes. It was also observed that in distilled water, solid dispersion atorvastatin with SSG and CPD the percentage release was 74.42% and 60.47% respectively up to 30 minutes which is found enhanced as compared to pure drug i.e. 20.82% release up to 30 minutes.

This result demonstrated that atorvastatin dissolution rate significantly enhanced by solid dispersion technique. As solid dispersion of atorvastatin with SSG and CPD in ratio of 1:7 shows maximum dissolution, it was decided to further compare the dissolution of atorvastatin solid dispersion (1:7) with marketed formulation. Hence Atorvastatin with SSG and CPD in ratio of 1:7 was formulated in to tablets for comparison.

Table 5: Cumulative % drug dissolved from pure drug and solid dispersion in distilled water

Time (min)	Formulation code										
	Pure Drug	ASSG1	ASSG3	ASSG5	ASSG7	PSSG7	ACPD1	ACPD3	ACPD5	ACPD7	PCPD7
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	2.33	3.61	13.54	15.58	17.53	11.33	8.02	13.88	21.01	21.60	11.50
10	5.91	7.30	25.40	36.12	38.94	19.18	14.14	35.93	40.25	41.36	17.06
15	7.73	14.08	45.12	46.53	49.30	26.35	21.76	40.91	42.82	45.13	19.37
20	11.59	24.17	54.27	49.85	58.50	37.85	35.24	43.65	52.79	54.45	25.44
30	20.82	43.96	65.31	71.37	74.42	52.35	42.76	46.84	57.02	60.47	38.62

Table 6: Cumulative % drug dissolved from pure drug and solid dispersion in phosphate buffer pH 6.8

Time (min)	Formulation code										
	Pure drug	ASSG1	ASSG3	ASSG5	ASSG7	PSSG7	ACPD1	ACPD3	ACPD5	ACPD7	PCPD7
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	3.78	17.36	18.97	18.80	19.22	16.76	14.97	15.58	16.61	15.69	18.56
10	6.77	40.96	41.14	48.36	46.92	30.27	20.92	36.86	39.03	45.41	31.70
15	15.29	45.44	47.40	59.40	60.76	35.70	32.52	44.14	46.81	54.73	35.70
20	20.56	47.64	54.11	62.19	64.15	37.93	36.63	48.78	51.64	61.90	40.10
30	28.05	52.06	58.65	70.85	76.81	52.06	42.44	51.40	58.90	64.10	41.14

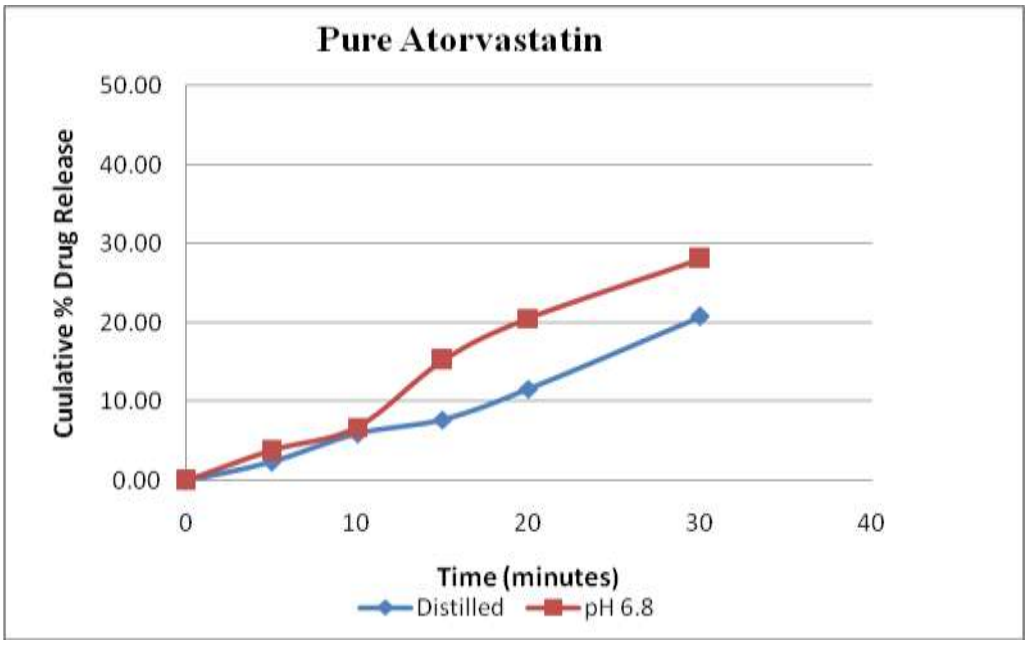

Figure 2: Cumulative % drug (Atorvastatin) dissolved in various medium

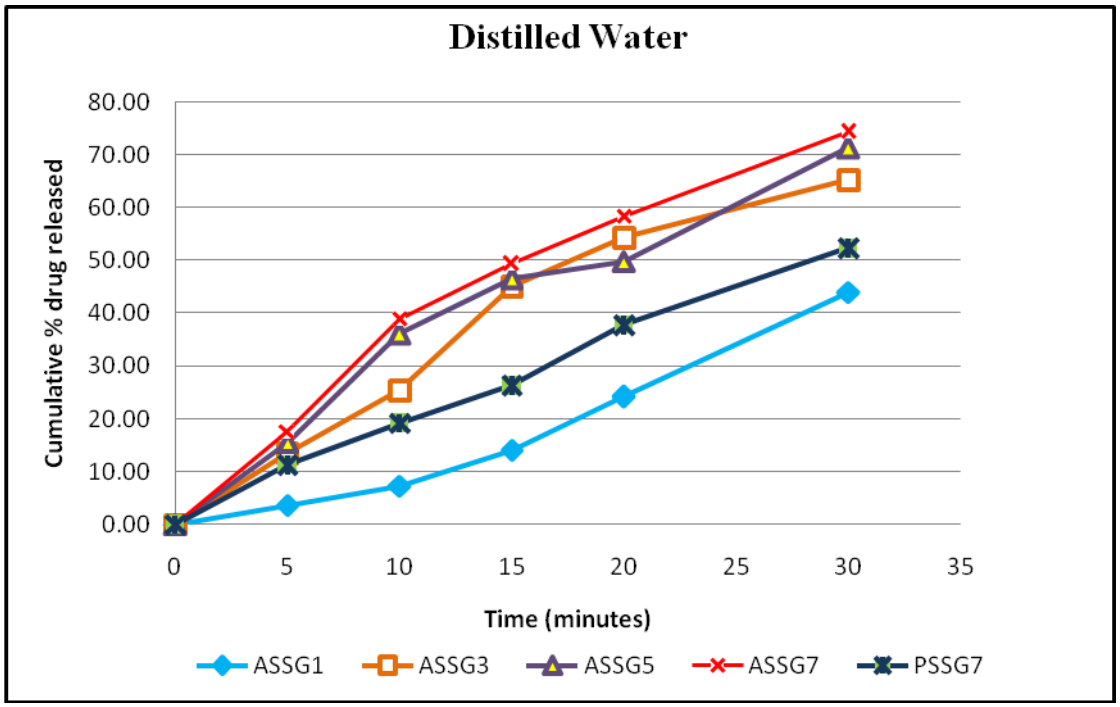

Figure 3: Cumulative % drug dissolved from solid dispersion of Drug: SSG in distilled water

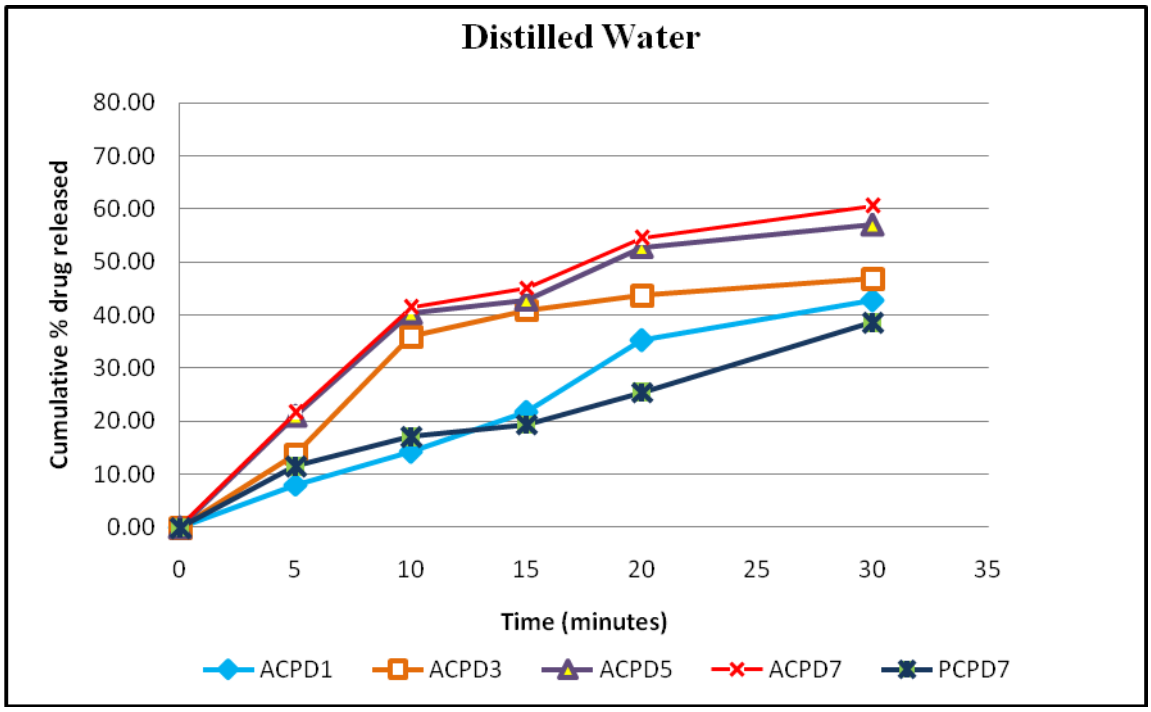

Figure 4: Cumulative % drug dissolved from solid dispersion of Drug: CPD in distilled water

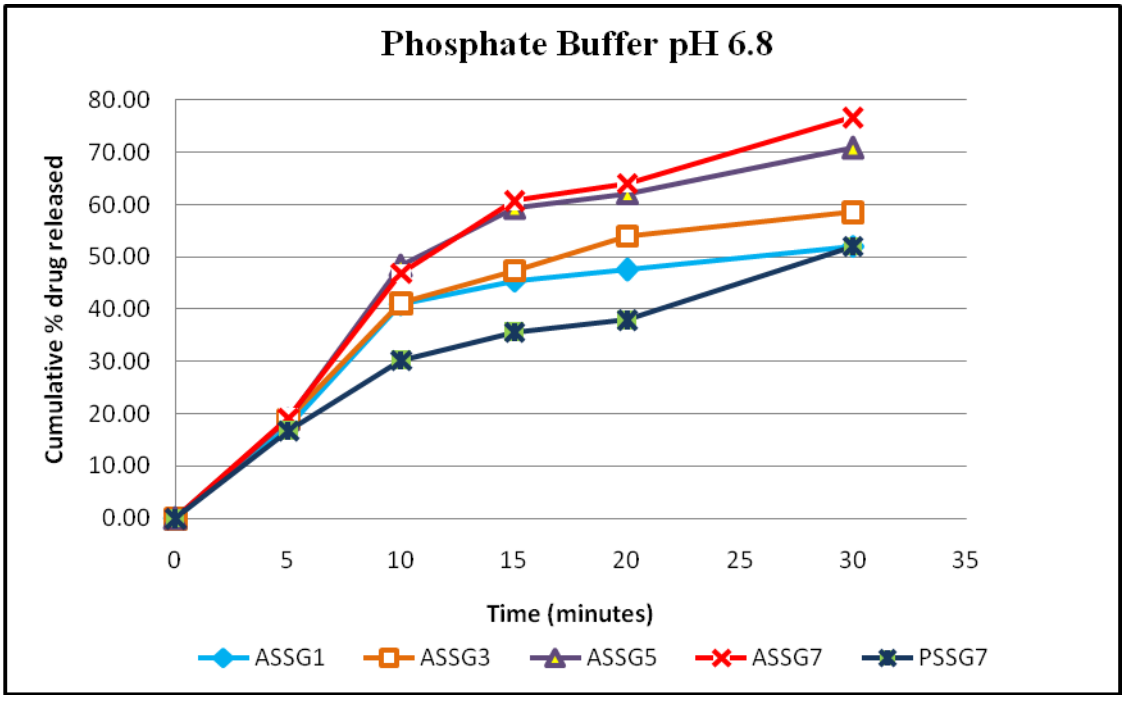

Figure 5: Cumulative % drug dissolved from solid dispersion of Drug: SSG in phosphate buffer pH 6.8

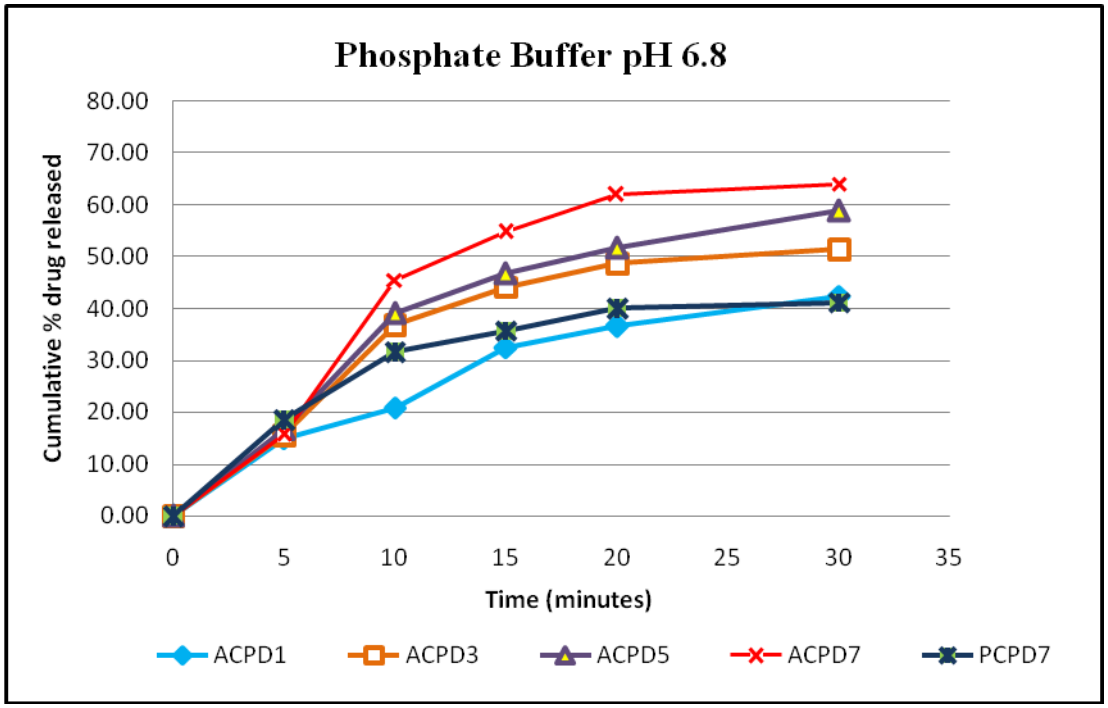

Figure 6: Cumulative % drug dissolved from solid dispersion of Drug: CPD in phosphate buffer pH 6.8

FTIR Spectroscopy study

FTIR was performed on Atorvastatin, SSG and CPD and solid dispersion of Atorvastatin with all carriers. The spectra Atorvastatin and all carriers were compared with that of solid dispersion of atorvastatin. The prominent peak of Atorvastatin, carriers and solid dispersion of Atorvastatin were obtained at the frequencies as depicted in (Figure 7-9) and (Table 7-9) shown FTIR interpretation respectively.

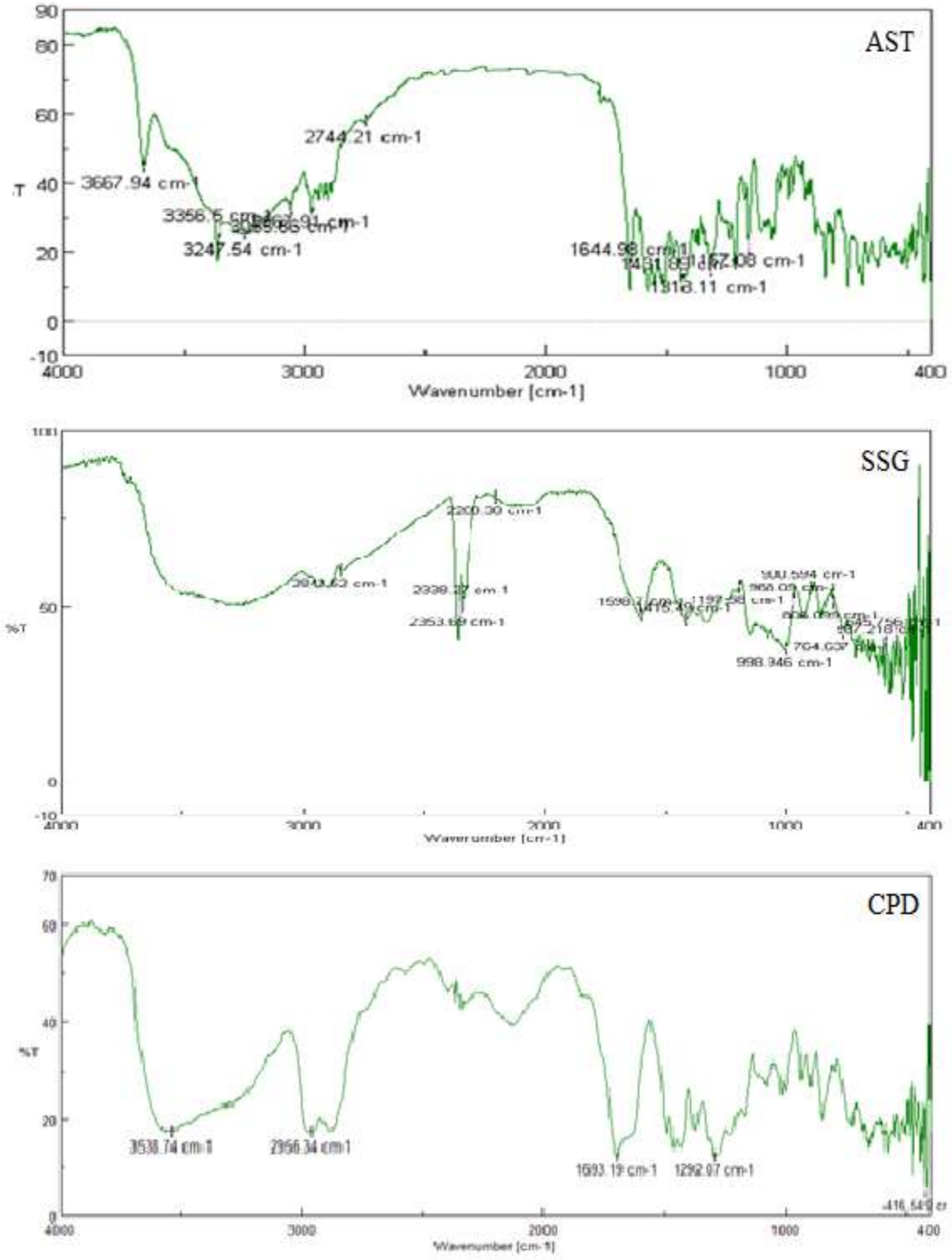

Figure 7: IR Spectrum of AST, SSG and CPD

Table 7: IR Interpretation of SSG

S N	Functional Group	Wave number in cm^{-1}	
		Range	SSG
1	-OH	3400-3200	3220.6
2	-C-O (In alcoholic)	1350-1260	1315.2
3	C-H	3000-2800	2848.62
4	C-O (In Ether)	1150-1070	1197.8

Table 8: IR Interpretation of CPD

S N	Functional Group	Wave number in cm^{-1}	
		Range	CPD
1	-C=O	1680-1630	1693.19
2	$-CH_2$	3000-2800	2956.34
3	C-N- (stretching)	1350-1180	1292.07

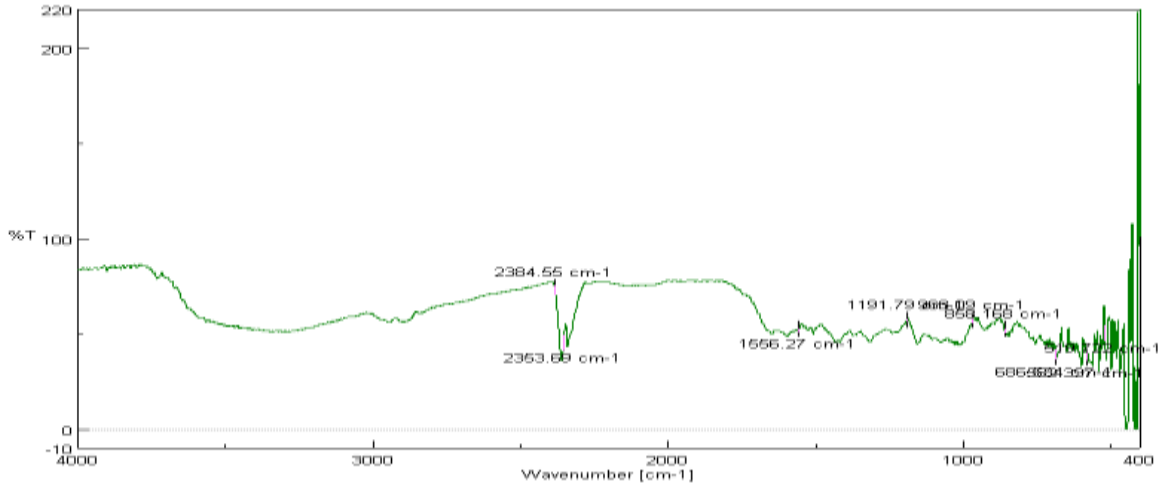

Figure 8: IR spectrum of ASSG7

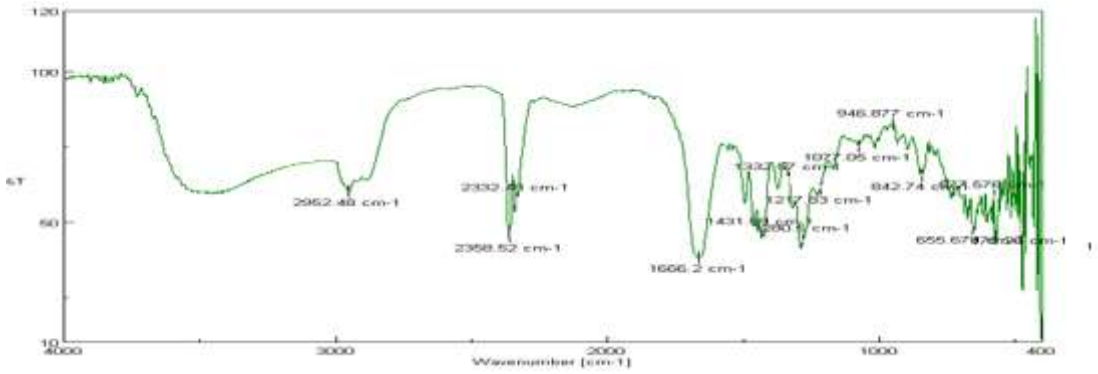

Figure 9: IR spectrum of ACPD7

Table 9: IR Interpretation of AST, ASSG7 and ACPD7

S N	Functional Group	Wave number in cm^{-1}			
		Range	AST	ASSG7	ACPD7
1	-OH	3400-3200	3356.6	3350	3280
2	N-H (stretching)	3350-3180	3247.54	3240.4	3210.14
3	-C=O	1680-1630	1644.98	1620.02	1666.2
4	Aliphatic -C-H	3000-2800	3005.65	2852.10	2952.48
5	-CH=CH-	1600-1475	1550	1556.27	1560
6	C-N- (stretching)	1350-1180	1318.11	1341.4	1332.52
7	C-F stretching	1400-1000	1110/1050	1080/988.09	1180.5/1077
8	C-O (stretching in alcohol/Ether)	1300-1000	1157.08	1191.79/1170	1217.83
9	$-CH_2$	3000-2800		2990	2895

The IR spectra of pure drug, pure polymer and solid dispersion are as shown in (Figure 7-9). The prominent peaks of atorvastatin was observed (Figure 7) the region of 3356.6 cm^{-1} due to the (-OH stretching), a peak at 3247.54 cm-1 due to the N-H stretching and a peak at 1644.94 cm-1 observed due to the carbonyl group. At the lower frequencies 1318.11 (C-N stretching), 1157.08 cm-1 (C-O stretching), 1110/1050 cm-1 for (C-F stretching) observed. The IR spectra of the solid dispersions (Figure 8-9) showed all the principal IR absorption peak of Atorvastatin.

The FTIR of solid dispersion of drug with all carriers shows that all peaks of drug and carriers are as it is and drug is present in free form. This indicates that there is no interaction in between Atorvastatin and carrier employed in the solid dispersion.

Differential scanning calorimetry (DSC):

DSC thermograms of Atorvastatin and optimised solid dispersion ASSG7 shown in (Figure 10-11) **.** DSC thermogram of Atorvastatin exhibited an endothermic peak at 163.83^{0}C corresponding to its melting point. This melting peak indicated the crystalline nature of atorvastatin. DSC curve figure revealed that both solid dispersion ASSG-7 and atorvastatin exhibited an endothermic peak with onset temperature of 154.71 and 163.83^{0}C respectively. However, in the case of solid dispersions, the endothermic peak of Atorvastatin disappeared and shifted toward a lower temperature which indicates that atorvastatin might be in an amorphous state. It might be attributed to the effect of carriers that inhibited crystallization of drugs, resulting in an amorphous state or a solid solution of Atorvastatin in solid dispersions.

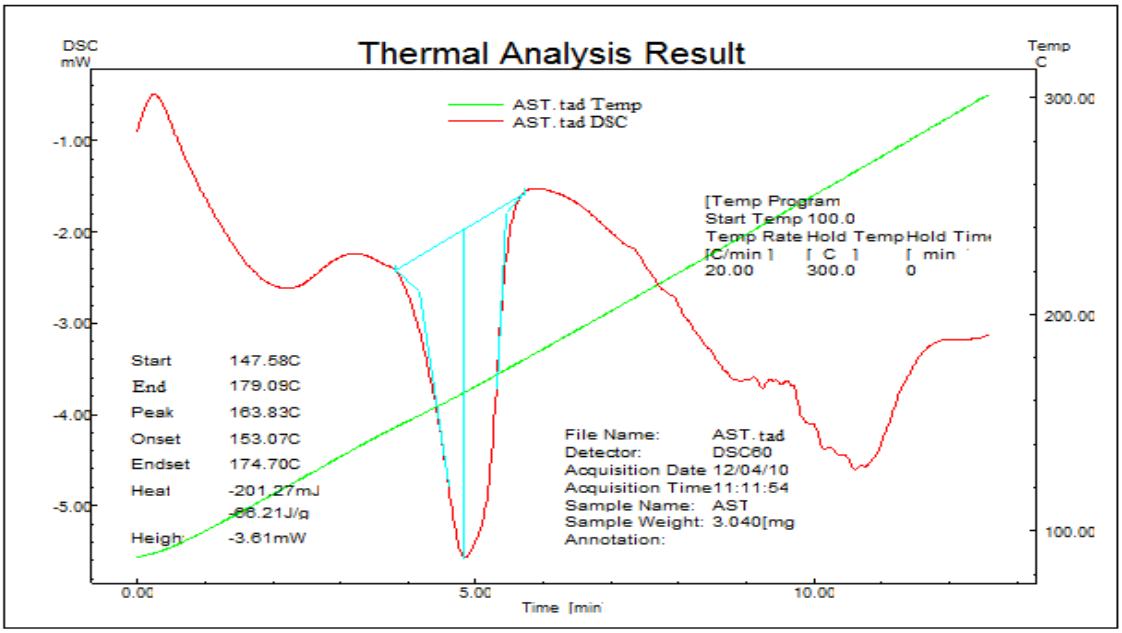

Figure 10: DSC thermograph of Atorvastatin

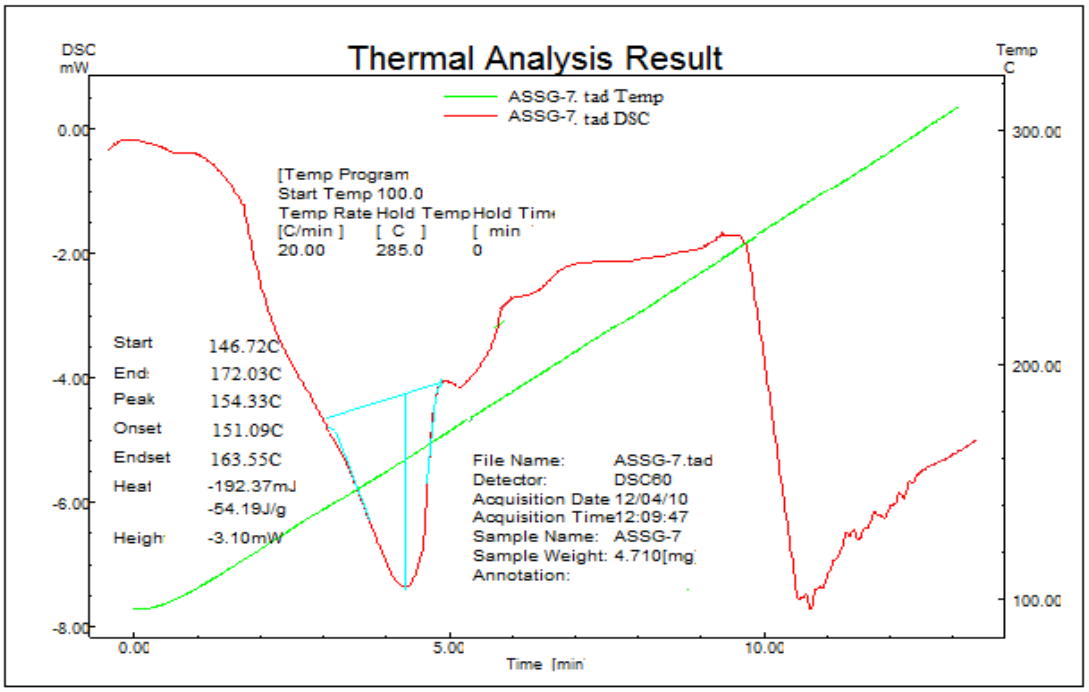

Figure 11: DSC thermograph of ASSG7

Cumulative % Drug release of Formulated tablet and Marketed tablets

The results of % drug release of the tablets are shown in (Table 10). % drug release of prepared tablets is compared with two marketed formulation (Atormac^{TM}). Prepared tablets shows higher drug release TSSG7 (73.02%) than marketed Atormac^{TM} (Macleods pharmaceuticals, Mumbai) tablet (70.08%).

Table 10: Cumulative % Drug release of formulated tablet and marketed tablets.

Time (min)	Formulation code	
	TSSG7	Atormac^{TM}
0	0.00	0.00
5	51.39	39.33
10	57.62	47.82
15	62.44	54.41
20	71.95	67.12
30	73.02	70.08

[TSSG7= Tablet containing solid dispersion of ASSG7]

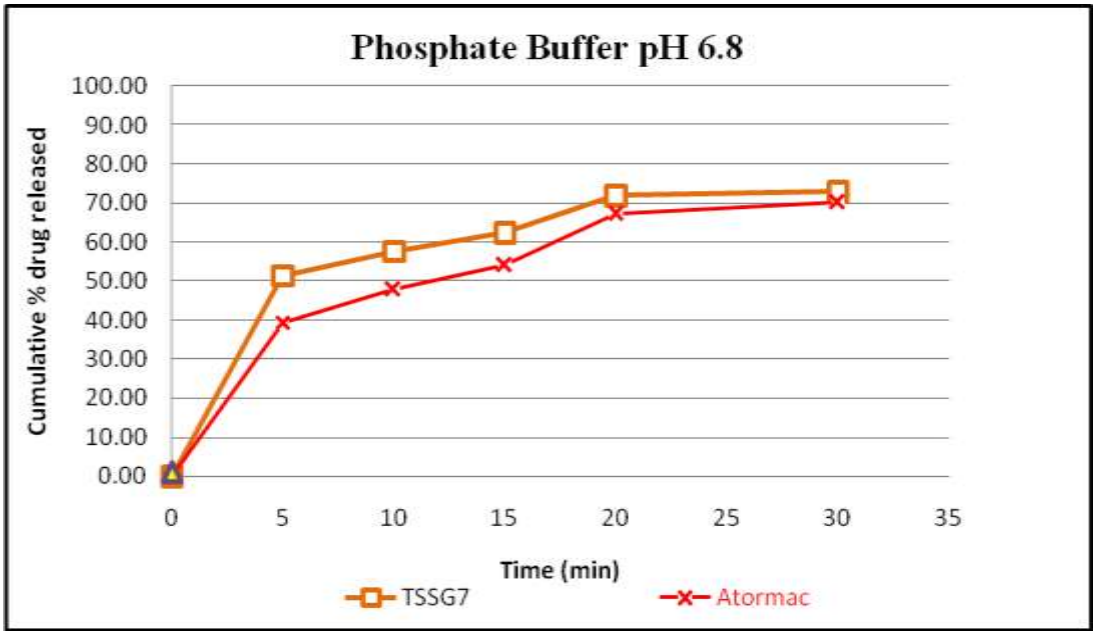

Figure 12: % Drug release of Formulated tablet and Marketed tablets.

Conclusion

From solubility and dissolution data that it may concluded that through a solid dispersion prepared by solvent evaporation method in ratio 1:7 shows enhancement in solubility and dissolution but solid dispersion of drug with SSG in ratio 1:7 w/w shows better solubility and dissolution enhancement and solubility was increased almost 4 folds from this dispersion. Tablets prepared containing optimised batch ASSG7 showed higher drug release with marketed tablets 73.02 % . FTIR data shows that there was no interaction between drug and carrier. DSC confirms the formation of amorphous nature.

Acknowledgement

I would like to express my utmost gratitude to my Research Guide Dr. Arunadevi S. Birajdar Principal, K.T.Patil College of Pharmacy Osmanabad for his constant help, unflinching guidance, critical comments, helpful suggestions and constructive criticism extended to me during the course of this study. I also thanks to Mr. Navale sir, Government College of pharmacy, Aurangabad for sanalyzing the Samples by DSC and IR.

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