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Enhancement of Water Solubility and Dissolution of Water Insoluble Drug Telmisartan by a Novel Powder Solution Technology

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ABSTRACT

The objective of the present study was to enhance the dissolution profile, absorption efficiency of water insoluble drugs like Telmisartan. A novel "Powder Solution Technology" involves absorption and adsorption efficiency, which makes use of liquid medications admixed with suitable carriers and coating materials and formulated into a free flowing, dry looking, non adherent and compressible powder forms. Based upon a new mathematical model expression improved flow characteristics and hardness of the formulation has been achieved by changing the proportion of carrier and coating material ratio from 15:1 to 5:1. Avicel ® PH 102 was showing acceptable flow properties compared with Avicel ®PH 200. Higher dissolution rates were observed in optimized liquisolid formulation containing Poly ethylene glycol 400 and Avicel ®PH 102 compared with marketed product (SARTAN® 20mg tablets). Poly ethylene glycol 400 was showing highest solubility compared with poly ethylene glycol 200, propylene glycol and glycerin.The crystalline state of telmisartan drug state was changed to amorphous state due to liquisolid formation and was confirmed by both X-ray diffraction and Fourier transform infrared spectroscopy results, this transition occur as the drug is in solution form. Additionally, increasing the wetting properties and subsequent surface area of the drug available for dissolution.

Keywords: Liquisolid tablets, Telmisartan, Polyethylene glycol, Dissolution, Powder solution Technology.

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INTRODUCTION

A more recent technique, entitled "powdered solution technology", has been applied to prepare water-insoluble drugs into rapid release solid dosage forms. Powdered solutions are designed to contain liquid medications in powdered form, thereby possessing mechanisms of drug delivery similar to those of soft gelatin capsule preparations containing liquids. The concept of powdered solutions enables one to convert drug solutions or liquid drugs into acceptably flowing powders by a simple admixture with selected powder excipients (e.g., cellulose and silica). This method does not involve drying or evaporation[1]. It is well established that better bioavailability of a relatively water-insoluble drug is achieved when the drug is in solution form. That is why soft gelatin capsules of such drugs demonstrate higher bioavailability compared to the conventional oral solid dosage forms[2]. The same principle governs powdered solutions and is solely responsible for their improved dissolution profiles[3]. In this instance, even though the drug is in a tableted or encapsulated dosage form, it is held in solution thus enhancing its release[4]. Liquid lipophilic drugs (e.g., chlorpheniramine and clofibrate) or solid drugs (e.g., prednisone, prednisolone, hydrocortisone, theophylline, polythiazide and spiranolactone) dissolved in nonvolatile, high-boiling point solvent systems (e.g., polyethylene & polypropylene glycols ,glycerin, N,N-dimethylacetamide, various oils) have been formulated in powdered solutions by admixture with various carriers (e.g., cellulose) and coating materials (e.g., silica). This technique has been reported to produce improved dissolution profiles as compared to the commercially available products[5]. Liao proposed mathematical expressions for the calculation of the amount of excipients needed for powdered solution formulations. The major draw back of this approach was that the final product exhibited poor and erratic flowability due to the inadequacy of the proposed model to calculate the appropriate amount of excipients required to produce powder admixtures of acceptable and consistent flow properties. Mathematical model expressions based on power properties and the fundamentals principles and mechanisms of powdered solutions are derived[6].

MATERIALS AND METHODS

Telmisartan gift sample from Alembic Limited, Gujarat, India, Avicel ®PH 200, Avicel® PH 102, Crospovidone gift samples from Vilin Biomed Ltd, Roorke, India. Aerosil ® PH 200 purchased from Zydus cadila, Ahmedabad, India, Hydrochloric acid Merck speciliates Pvt Ltd, Mumbai, India, PEG 400, PEG 400 and Propylene glycol gift samples from S.d.fine chem Ltd, Mumbai, India. Standard graph of telmisartan was done using 0.1 N HCl solution and The absorbance of these samples was measured spectrophotometrically at 288nm using UV- Visible

spectrophotometer.

Preformulation Studies - Solubility Studies

For the selection of best non volatile solvents solubility studies were conducted, in this procedure, pure drug was dissolved in five different non volatile solvents. Excess amount of pure drug was added to the non volatile solvents. This saturation solution was kept on the rotary shaker for 48 hours at 25 ^{0}C under constant vibration. After 48 hours period the saturated solution was filtered through a filter paper, and analyzed by UV spectrophotometer. The liquisolid tablets contain a solution of the drug in suitable solvent, the drug surface available for dissolution is tremendously increased.

Calculation of Loading Factor (L_f)

Loading factors were calculated for different carriers, using various solvents. By using L_f = W/Q formula (W: Amount of liquid medication and Q: Amount of carrier material), the drug loading factors were obtained and used for calculating the amount of carrier and coating materials in each formulation. The results showed that if the viscosity of the solvent is higher, lower amounts of carrier and coating materials are needed to produce flowable powder[7].

Micromeritic Properties

Angle of Repose, bulk desity, carr's index, Hausner's Ratio and tapped density were performed.

Preparation of Liquisolid Tablets

Preparation of Drug Solution: For the preparation of liquisolid compacts of telmisartan, a non-volatile solvent is chosen for dissolving the drug. From the results of solubility studies and evaluation of flow properties, liquisolid powders containing PEG 400 as the liquid medicament, Avicel ® PH 102, Avicel ® PH 200 as carrier and Aerosil ® PH 200 as the coating material is selected for the preparation of liquisolid compacts. Various ratios of carrier to coating materials are selected. According to solubility of telmisartan, desired quantities of drug and PEG 400 were accurately weighed in a beaker and then stirred continuously, until a homogenous drug solution was obtained. Selected amounts (W) of the resultant liquid medication were incorporated into calculated quantities of carrier contained in a mortar.

Mixing: The mixing procedure was conducted in three stages. During the first stage, the system was blended at an approximate mixing rate of one rotation/sec for approximately one minute in order to evenly distribute the liquid medication into the powder. In the second mixing stage, calculated quantities of coating material was added to the system and blended for 2 min. the liquid/powder admixture was evenly spread as a uniform layer on the surfaces of the mortar and left standing for approximately 5min to allow the drug solution to be absorbed in interior of the

powder particles. In the third stage, the powder was scraped off the mortar surfaces by means of aluminum spatula and then blended with a calculated quantity of disintegrant (5%) for another 30sec, in a manner similar to the one used in the first stage, producing the final liquisolid formulation to be compressed.

Table 1: Composition of telmisartan liquisolid tablets

Formulation	Telmisartan conc.in PEG 400	R	L_f	Avicel®PH 200 (mg)	Avicel®PH 102(mg)	Aerosil®PH 200(mg)	Total tablet weight(mg)
F1	10%	5	0.55	400	-	80.0	735
F2		10	0.55	400	-	40.0	693
F3		15	0.55	400	-	26.6	679
F4	20%	5	0.6	400	-	40.0	378
F5		10	0.6	200	-	20.0	357
F6		15	0.6	200	-	13.3	350
F7	30%	5	0.433	200	-	40.0	343
F8		10	0.433	200	-	20.0	322
F9		15	0.433	200	-	13.3	315
F10	10%	5	0.55	-	400	80.0	735
F11		10	0.55	-	400	40.0	693
F12		15	0.55	-	400	26.6	679
F13	20%	5	0.6	-	200	40.0	378
F14		10	0.6	-	200	20.0	357
F15		15	0.6	-	200	13.3	350
F16	30%	5	0.433	-	200	40.0	343
F17		10	0.433	-	200	20.0	322
F18		15	0.433	-	200	13.3	315

Note: All formulations contain 5% crospovidone as a super disintegrant. L_f = Load factor; R= carrier and coating material ratio; PEG 400 =Poly Ethylene Glycol 400.

Evaluation of Liquisolid Tablets

Tablets were evaluated for Thickness, weight variation, Friability, assay, Disitegration, in-vitro dissolution studies, X-ray diffraction, and drug interaction study by FTIR.

Procedure for Assay

The drug content was performed by taking five randomly selected liquisolid tablets of each formulation. The five tablets were grinded in a mortar to get powder; this powder was dissolved in 0.1 N HCl by sonication for 30 min and filtered through filter paper. The drug content was analyzed spectrophotometrically at 288 nm using UV spectrophotometer. Each measurement was carried out in triplicate and the average drug content was calculated.

Disintegration Test

Six tablets were taken randomly from each batch and placed in USP disintegration apparatus

baskets. Apparatus was run for 10 minutes and the basket was lifted from the fluid, and observed whether all the tablets have disintegrated.

Dissolution Test of Telmisartan Liquisolid Tablets Drug release from telmisartan liquisolid tablets was determined by using dissolution test United States Pharmacopoeia (USP) 24 type II (paddle). Dissolution medium0.1 N HCl, Volume 900 ml .Temperature at 37^0C± 0.5^0C,Speed 100 rpm 5ml aliquots of dissolution media were withdrawn each time at suitable time intervals (5, 10, 20, 30, 45 minutes.) and replaced with fresh medium. The samples were filtered, suitably diluted and analyzed by UV spectrophotometer. The concentration was calculated using standard calibration curve.

Data Treatment of Dissolution Studies: Dissolution Efficiency (DE_T): A model independent parameter, the dissolution efficiency (DE_T) was employed to compare dissolution profiles of different samples. DE_T was calculated according to the following equation[8].

$$DE_T = \frac{\int_0^T y_t . dt}{y_{100} . T}$$

Where y_t is % of drug dissolved at any time t, denotes y_{100} 100% dissolution, the integral represents the area under dissolution curve between time zero and T.

Mean Dissolution Time (MDT): Mean dissolution time was employed to compare dissolution profiles of different samples. MDT was calculated according to the following equation.

$$MDT = \sum_{j=1}^{n} * tj * \delta Mj / \sum_{j=1}^{n} * \delta Mj$$

Here j=sample number; n= no. of dissolution times: tj = time at mid point between tj and tj-1, δMj= additional amount of drug release between tj and tj-1.

Initial Drug Release: The initial drug release was used to calculate the amount of drug released for 1 minute in optimized liquisolid formulation and marketed formulation.

Relative Dissolution Rate: It was used to calculate the relative dissolution rate in 10 minutes between optimized formulation and marketed formulation[9].

X-Ray Powder Diffraction (XRD) studies

X-ray powder diffraction studies were conducted for characterization of the different polymorphic forms of solvated and unsolvated forms of compounds using Phillips PW 3719, Netherlands. These samples were then exposed to Cu-K_α radiation at a scan rate of 2^0/ min over the 2θrange of 3-40^0C.

Fourier Transform Infrared Spectroscopy (FTIR)

FTIR studies were performed on drug, excipients and the optimized formulation using Jasco V5300 FT-IR (Tokyo, Japan) (Brite labs, Hyderabad, India). The samples were analyzed between wave numbers 4000 and 400 cm^{-1}.

RESULTS AND DISCUSSIONS

Solubility Studies: The solubility of telmisartan in different non volatile solvents (PEG 400, PEG 200, Glycerin and Propylene glycol) was shown in table 2. The table shows that telmisartan has highest solubility in PEG 400. Since our aim is to increase the dissolution rate of telmisartan, PEG 400 was selected as a non volatile solvent in the preparation of liquisolid systems.

Table 2: Solubility Studies of Telmisartan in Non Volatile Solvents

S. No.	Solvent	Solubility (mg/ml)
1.	PEG 400	16±0.5
2.	PEG 200	14±0.6
3.	Glycerin	4±0.5
4.	Propylene glycol	7±0.6

Calculation of loading factor (L_f)

Loading factors were calculated for different carriers, using various co-solvents. By using L_f = W/Q formula (W: Amount of liquid medication and Q: Amount of carrier material), the drug loading factors were obtained and used for calculating the amount of carrier and coating materials in each formulation[10].

Precompression evaluation studies for telmisartan liquisolid tablets

The flowability of a powder is of critical importance and is influenced by many interrelated factors; the factors include physical, mechanical as well as environmental factors[11]. Therefore, in our study, because of the subjective nature of the individual types of measurements as indicators of powder flow, three flow measurement types were employed; the angle of repose, Carr's index (compressibility index), and Hausner's ratio. As the angle of repose (θ) is a characteristic of the internal friction or cohesion of the particles, the value of the angle of repose will be high if the powder is cohesive and low if the powder is non cohesive.F4=33.1±0.2, F5=34.7±0.3, F7=33.5±0.1, F8=34.9±0.2, F9=34.8±0.4, F10=34.5±0.7, F13=32.2±0.4, f14=34.6±0.3, F16=33.2±0.3,F17=34.1±0.2, F18=±0.7; were chosen as liquisolid systems with acceptable flowability according to the angle of repose measurements, while those having higher angles of repose were considered as non-acceptable.

Powders showing Carr's index (%) up to 21 are considered of acceptable flow properties[12]. In addition to Carr's index, Hausner found that the ratio $D_{Bmax/DBmin}$ was related to the inter particle

friction, so, he showed that powders with low inter particle friction, had ratios of approximately 1.25 indicating good flow[13]. Therefore F1, F2, F4, F5, F6 , F7, F8, F9, F10, F11, F13, F14, F15, F16, F18 were selected as acceptably flowing as they had average carr's index of 14.2±0.2; 19.9±0.4; 12.5±0.8; 13.3±0.9; 17.2±0.9; 10.4±0.1; 17.5±0.4; 15.4±0.9; 12.9±0.3; 17.0±0.3; 10.8±0.6; 13.3±0.9; 17.1±0.4; 10.4±0.1; 19.5±0.9 respectively, and average Hausner's ratios of 1.16±0.01; 1.14±0.02; 1.15±0.01; 1.20±0.01; 1.11±0.02; 1.14±0.01; 1.20±0.02, 1.12±0.02, 1.11±0.01, in the same order.

Finally, formulae F4, F5, F7, F8, F9, F10, F13, F14 and F16 that were proven to be acceptably flowing according to either the angle of repose , Carr's index and Hausner's ratio were compressed into tablets and subjected for further evaluation while the rest of formulae were nominated as having unacceptable flowability and therefore excluded from further investigation.

All the telmisartan liquisolid tablets had acceptable friability as none of the tested formulae had percentage loss in tablets weights that exceed 1% also, no tablet was cracked, split or broken in either formula. Since all the prepared formulae met the standard friability criteria, they are expected to show acceptable durability and withstand abrasion in handling, packaging and shipment. In general, formulation should be directed at optimizing tablet hardness without applying excessive compression force, while at the same time assuring rapid tablet disintegration and drug dissolution. In other words, tablets should be sufficiently hard to resist breaking during normal handling and yet soft enough to disintegrate properly after swallowing[14].

The mean hardness of each liquisolid formula was determined and proved that all the liquisolid tablet formulae had acceptable hardness. The hydrogen bonds between hydrogen groups on adjacent cellulose molecules in Avicel may account almost exclusively for the strength and cohesiveness of compacts [15]. The high compressibility and compactness of Avicel can be explained by the nature of the microcrystalline cellulose particles themselves which are held together by hydrogen bonds, when compressed, such particles are deformed plastically and a strong compact is formed due to the extremely large number of surfaces brought in contact during the plastic deformation and the strength of the hydrogen bonds formed.The disintegration time test revealed that the liquisolid tablet formulae F4, F5, F6, F7, F9, F13, F14, F15, F16, and F18 disintegrated in less than 120 seconds (110±5, 115±5, 100±4, 120±5, 120±2, 110±4, 115±5, 100±4, 120±5 and 120±2 seconds respectively). All the formulations should meet the required USP specifications. Since our aim was to improve telmisartan dissolution rate via improving the tablets' physical characteristics.

***In vitro* release studies**

Spireas [16] clarified that the liquisolid hypothesis suggests that when the drug dissolved in the liquid vehicle is incorporated into a carrier material which has a porous surface and closely matted fibers in its interior as cellulose, both absorption and adsorption take place; i.e., the liquid initially absorbed in the interior of the particles is captured by its internal structure, and after the saturation of this process, adsorption of the liquid onto the internal and external surfaces of the porous carrier particles occur. Then, the coating material having high adsorptive properties and large specific surface area gives the liquisolid system the desirable flow characteristics. Liquisolid formulations containing 10% and 20% drug solution, (Figure 1, 2) exhibited similar drug release profiles with a very small variations but these release profiles were found to be higher for the F1, F2, F3 formulations, probably due to the higher amount of PEG 400, which might have contributed to the increase in the saturation solubility of the drug at the microenvironment. It may be possible that the infinite amounts of PEG 400 get diffused with the drug molecules out of a single liquisolid particle[17] and excessive amount of Avicel ® PH 200, which is responsible for its disintegration property. F1 and F4 formulations also showed the higher dissolution profiles (96.7%, 94.6%) when compared to the rest of the two formulations in 10% (F2=887.1%, F3=83.94%) and 20% (F5=93.6%, F6=93.3%). This may be due to the higher amount of Aerosil ® PH 200 which aid in adsorbing excessive amount of liquid in the physical mixture.

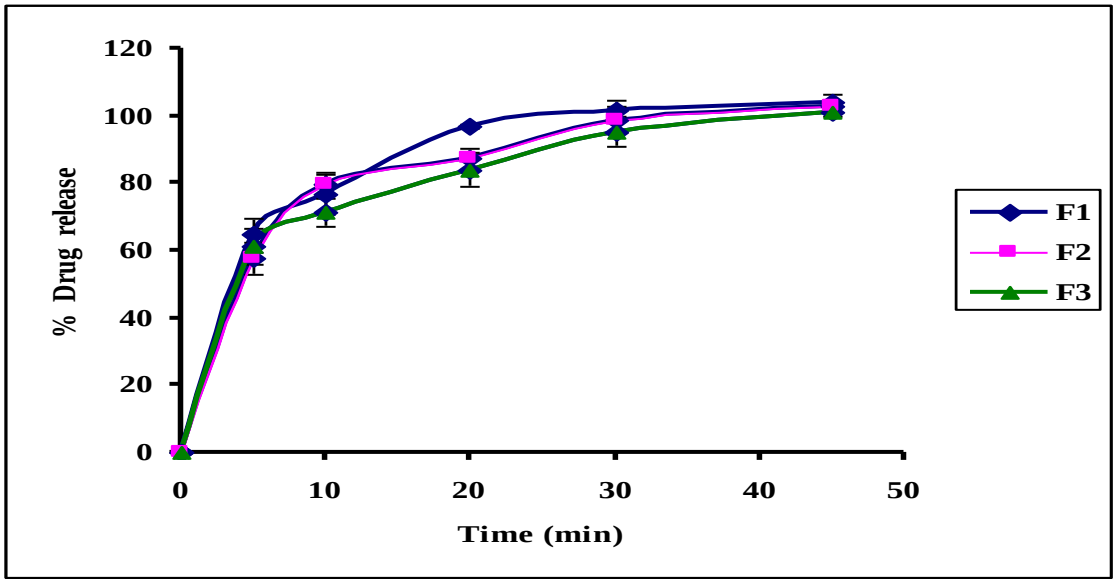

Figure 1: Dissolution profiles of telmisartan in PEG 400 (10% w/w) using Avicel ®PH 200 as carrier of liquisolid tablets.Data represents mean ± S.D (n=3).

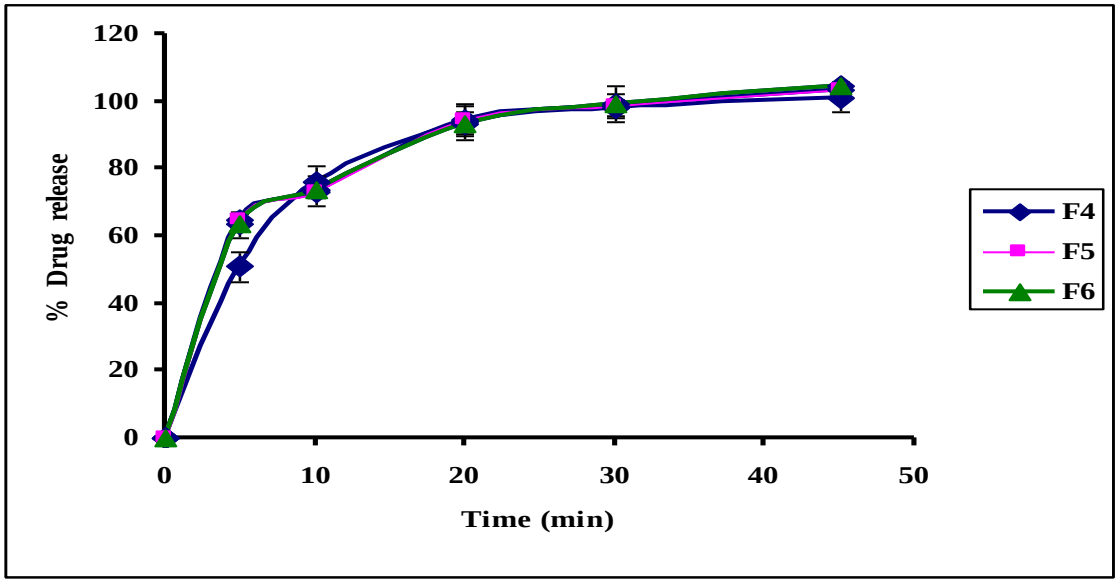

Figure 2: Dissolution profiles of telmisartan in PEG 400 (20% w/w) using Avicel ®PH 200 as carrier of liquisolid tablets. Data represents mean ± S.D (n=3).

Liquisolid formulations (F7,F8, F9) containing 30% drug solution in the Figure 5 showed lowest drug release profiles (64.75%, 73.62%, 71.65%) in 20 minutes when compared to 10% drug solution and 20% drug solution , because of low amount of PEG 400. In these formulations drug is dispersed in the solvent, formed as drug suspension further showing no change in drug state. But, these formulations are showing excellent flow properties may be due to low amount of PEG 400. The evaluation parameters of these three formulations were observed in acceptable range.

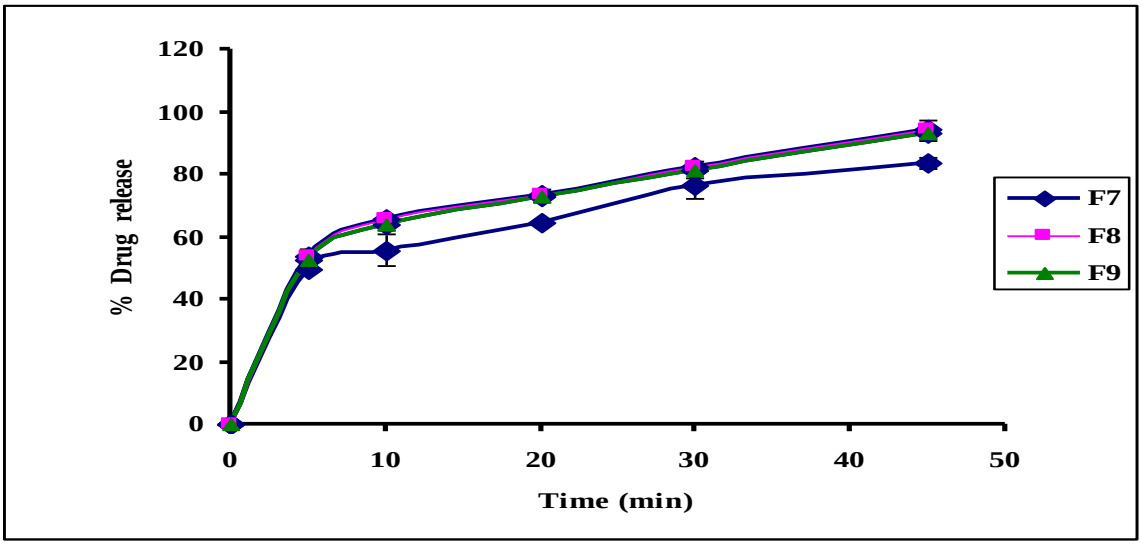

Figure 3: Dissolution profiles of telmisatan in PEG 400 (30% w/w) using Avicel ®PH 200 as carrier of liquisolid tablets. Data represents mean ± S.D (n=3).

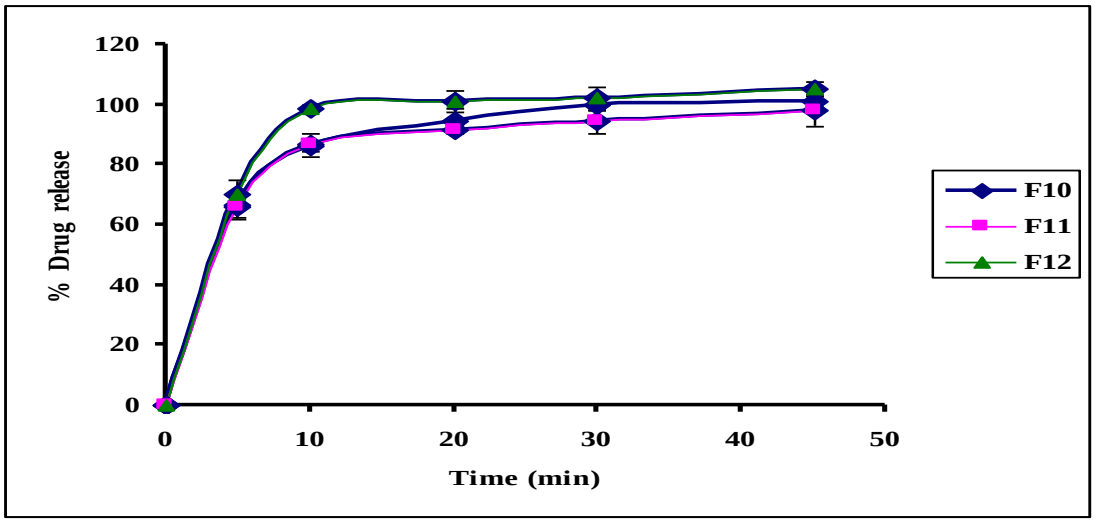

Figure 4: Dissolution profiles of telmisartan in PEG 400 (10% w/w) using Avicel ®PH 102 as carrier of liquisolid tablets. Data represents mean ± S.D (n=3).

Liquisolid formulations (F10, F11, F12) prepared by using Avicel 102 as a carrier with 10% drug solution shown in the Figure 4 depicts that F12 formulation was showing (100.92%) higher drug release. when compared with F1 and F4 formulations. Rests of the two formulations are showing (94.62%, 91.63%) drug release profiles. But these formulations are showing good flow properties (Angle of repose (θ) 34.5±0.7, 35.9±0.5, 34.2±0.6 respectively) because of Avicel® PH 102 having high surface area. Aerosil® PH 200 may be influencing the flow properties as well as dissolution rate.

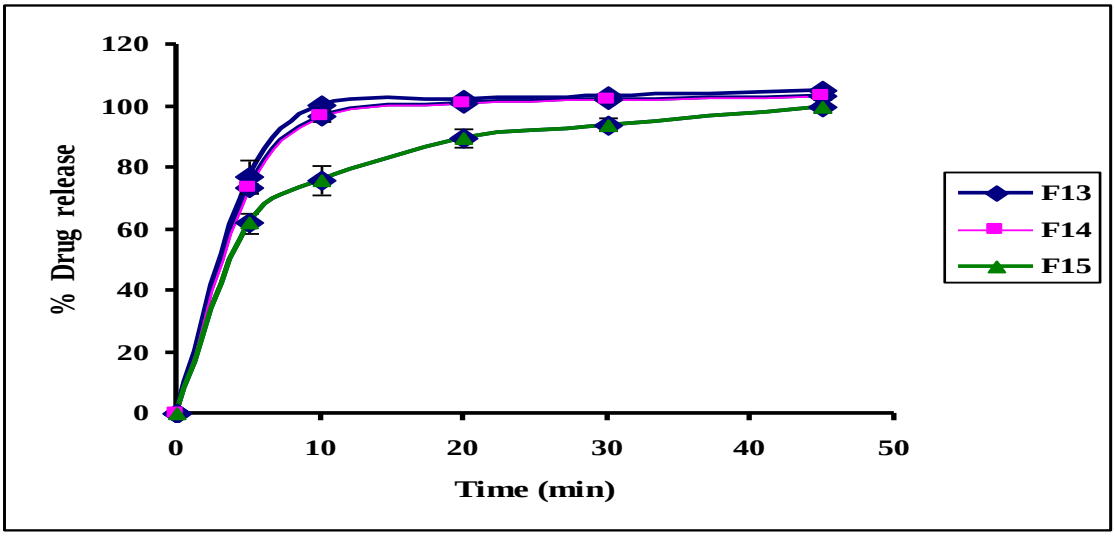

Figure 5: Dissolution profiles of telmisartan in PEG 400 (20% w/w) using Avicel ®PH 102 as carrier of liquisolid tablets. Data represents mean ± S.D (n=3).

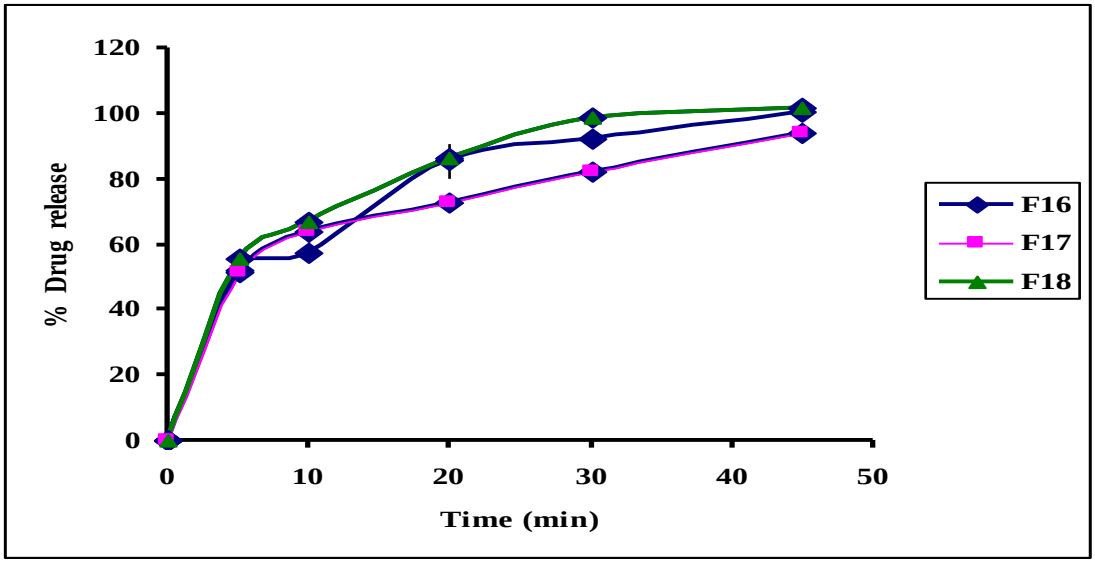

Figure 6: Dissolution profiles of telmisartan in PEG 400 (30% w/w) using Avicel ®PH 102 as carrier of liquisolid tablets. Data represents mean ± S.D (n=3).

F16, F17, F18 liquisolid formulations contains 30% drug solution and Avicel ® PH 102 used as a carrier. These formulations are having low amount of solvent, so solvent was not sufficient to solubilize the drug. Therefore, these three formulations are showing low dissolution profiles and excellent flow properties were observed. In Figure 5, optimized formulation F13 was showing highest dissolution rate (100.12%) when compared with marketed product (Sartan ® 20mg tablets), it was showing less dissolution rate (77.25%) within ten minutes. All telmisartan liquisolid tablets were showing acceptable content uniformity. The most important observation is that PEG 400 containing formulations had higher drug dissolution rate than the conventional ,this could be explained according to the " Noyes Whitneys " equation and the diffusion model dissolution theories, the dissolution rate of a drug (D_R) is equal to

$$D_R = (D/h)\ S\ (Cs-C)$$

where h is the thickness of the stagnant diffusion layer formed by the dissolving liquid around the drug particles, D is the diffusion coefficient of the drug molecules transported through it, S is the surface area of the drug available for dissolution, C is the drug concentration in the bulk of the dissolving medium, and finally Cs is the saturation solubility of the drug in the dissolution medium, and thus it is a constant characteristic property related to the drug and dissolving liquid involved. Since all of dissolution tests for formulations were done at a constant rotational paddle speed (100 rpm) and identical dissolution media, we can safely assume that the thickness of the stagnant diffusion layer (h) and the diffusion coefficient of the drug molecules remain almost identical. From the previous equation, the drug dissolution rate is directly proportional not only to

the concentration gradient of the drug in the stagnant diffusion layer (Cs - C), but also to its surface area (S) available for dissolution. Since the liquisolid tablets contain a solution of the drug in suitable solvent, the drug surface available for dissolution is tremendously increased. In essence, after tablet disintegration, the liquisolid primary particles suspended in the dissolving medium contain the drug in a state of molecular dispersion, whereas the directly compressed tablets are merely exposing micronized drug particles. In other words, in the case of liquisolid tablets, the surface of drug available for dissolution is related to its specific molecular surface which by any means, is much greater than that of the telmisartan particles delivered by the plain, directly compressed tablets. Therefore, the hypothesis that the significantly increased surface of the molecularly dispersed telmisartan in the liquisolid tablets may be chiefly responsible for their observed higher and consistent drug dissolution rates appears to be fundamentally valid. In addition to the proceeding theory, it might be also speculated that Cs, the saturated solubility of the drug at the microenvironment, might be increased in the case of liquisolid system. However, at the local level, the solid/liquid interface between an individual liquisolid primary particle and the dissolving fluid involves minute quantities of aqueous medium clinging onto the particle surface to form the stagnant diffusion layer. At such micro-environment, it is quite possible that the infinite amounts of PEG 400 diffusing with the drug molecules out of a single liquisolid particle might be adequate to enhance the solubility of telmisartan acting as a co-solvent with the aqueous dissolution medium of the stagnant diffusion layer. Such an increase in Cs will result, of course, in a larger drug concentration gradient (Cs- C) thereby increasing the dissolution rate as defined by the Noyes–Whitney equation[18,19]. The study on hydrocortisone liquisolid tablets verified that liquisolid tablets due to their increased wetting properties and surface of drug available for dissolution demonstrated significantly higher drug release rates than those of conventionally made, directly compressed tablets containing micronized hydrocortisone.Moreover, it was previously established that the higher dissolution rates displayed by liquisolid compacts, in comparison with conventional tablets, may also imply enhanced oral bioavailability due to increased wetting properties and surface of drug available for dissolution. Therefore, they proved that the liquisolid technique can be a promising alternative for the formulation of water-insoluble drugs into rapid release tablets.

Data Treatment of Dissolution Studies

The amount of drug release in ten minutes (Q10) of the optimized formulation (F13) and marketed formulation was 100.1% and 77.2% respectively. The initial drug release for F13 formulation was 10.01% compared to the marketed product (7.72%). The dissolution efficiency of the optimized

formulation (F13) was 63.3%, which was found to be significantly higher compared to marketed product (47.3%). The lower the mean dissolution time for a formulation better the dissolution characteristics, in this case we could observe a lower mean dissolution time of 7.37 minutes for liquisolid tablet compared to marketed product i.e., 12.27 minutes shown in table 3. The dissolution enhancement as described in terms of relative dissolution rate was also higher for liquisolid tablets compared to marketed product (Figure 7).The dissolution performance of telmisartan was improved with liquisolid formulation compared to marketed tablet as described by the dissolution parameters. The drug is not in the native form and adsorbed onto a carrier in suspended form, the enhanced effective surface area and change in the physical state could have led to the improved dissolution characteristics for liquisolid system.

Table 3: Dissolution parameters of Marketed product and optimized liquisolid formulation

	Q10	IDR	DE	MDT(min)	RDR
Sartan	77.2%	7.72%	47.3%	12.27	--
Liquisolid	100.1%	10.01%	63.3%	7.37	1.33

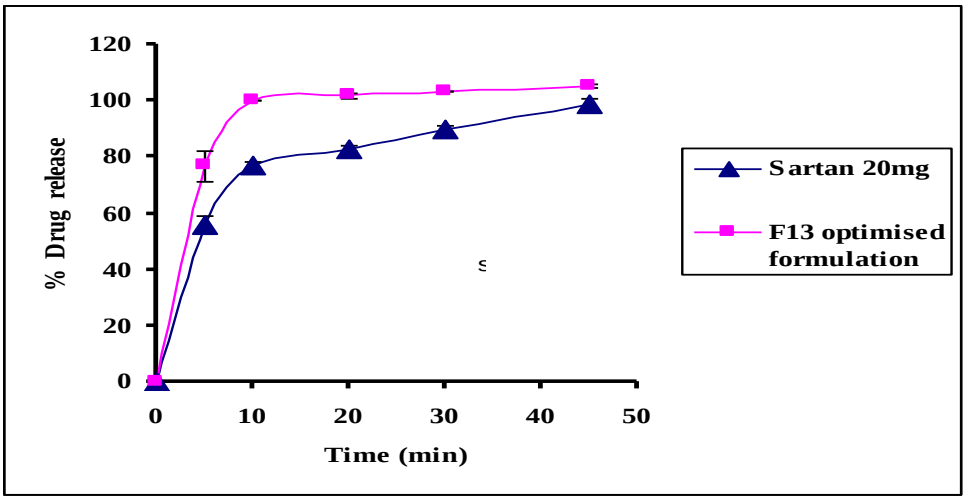

Figure 7: Comparison of dissolution profiles of optimized formulation with marketed product

X-Ray Diffraction

X Ray Diffraction (XRD) is a technique of choice to identify different polymorphic forms of a compound and also used to identify the solvated and unsolvated forms of a compound. X-ray diffraction studies in figure 10.a showed sharp, distinct peaks at 7.2º, 15.2º, 19.2 º, 23.1º and 25.1º confirms that it is in the crystalline state. The mixture of X-ray diffraction of liquisolid powder shown in figure8.c indicate the absence of telmisartan constructive peaks and it is having only one sharp peak at 22.8º as that of Avicel PH 102 shown in figure 8.e and points out that telmisartan has

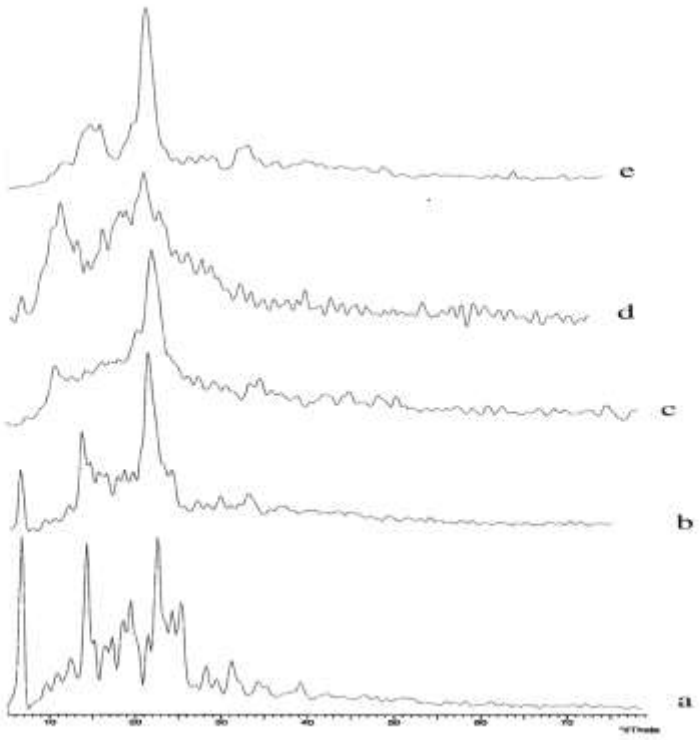

Figure 8: X-Ray Diffractions of (a) Telmisartan (b) Telmisartan : Avicel PH 102 (c) Liquisolid powder system (d)Telmisartan : Aerosil (d) Avicel PH 102.

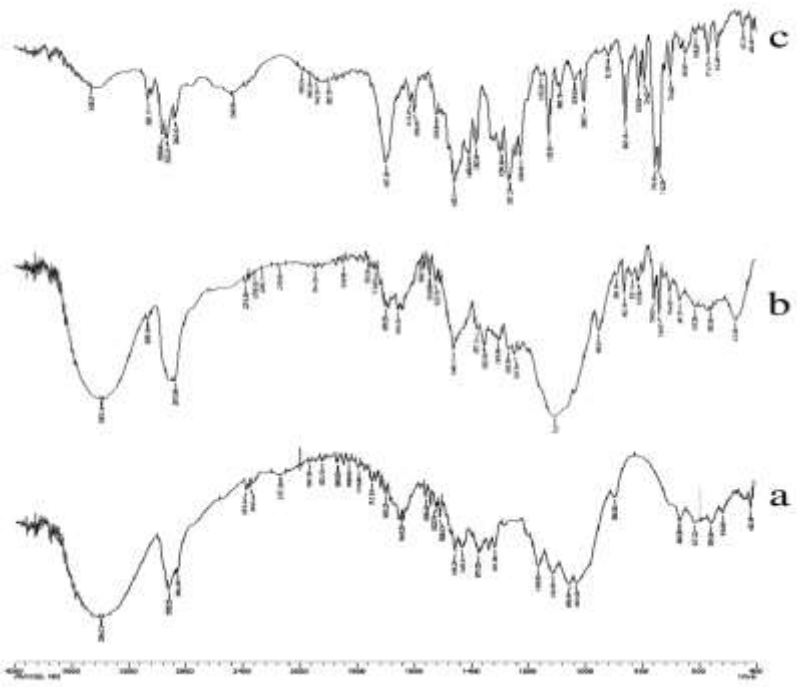

Figure 9: Fourier Transform Infrared Spectroscopy of (a) Avicel PH 102 (b) Liquisolid powder system (c) Telmisartan

almost entirely converted from crystalline to amorphous state due to telmisartan solubilization in the liquid vehicle that was absorbed into the carrier such as Avicel PH 102 and adsorbed on to the coating material such as Aerosil PH 200. Figure 8.b and figure 8.d exhibiting telmisartan characteristic peaks were observed in the physical mixture showing that crystalline structures remained unchanged during the physical mixing.

Fourier Transform Infrared Spectroscopy

The FTIR spectra were shown in figure 9.a, 9.b, 9.c. In figure 9.c the peak at 3458.37cm^{-1} is the characteristic of the heterocyclic amine NH stretch and the peak at 2988.80cm^{-1} is the characteristic of the methylene -CH_2- group in the drug (telmisartan).The peak at 3383.14 cm^{-1} is the characteristic of the polymeric OH stretch and the peak at 3394.72 cm^{-1} is also the characteristic of the polymeric OH stretch in the polymer and the liquisolid powder.

CONCLUSION

The liquisolid tablets prepared using avicel pH 102 showed good flow properties and hardness than with avicel pH 200. The optimized formulation F13 containing 20% drug solution at 5:1 carrier to coating material showed highest dissolution rate. The optimized liquisolid formulation of telmisartan showed highest dissolution rate when compared with marketed product (Sartan 20mg). Due to increase in wetting properties and surface area of drug available for dissolution media, X-Ray Diffraction and Fourier Transform Infrared Spectroscopy results were proving that telmisartan has almost entirely converted from crystalline.

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