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Research Article

SOLUBILITY ENHANCEMENT POTENTIAL OF TAMARIND SEED POLYSACCHARIDE AS A SOLUBILIZER

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ABSTRACT

Solubility behavior of a drug is one of the key determinants of its oral bioavailability. In recent years, the number of poorly soluble drug candidates has increased tremendously. The formulation of poorly soluble drugs for oral delivery presents a challenge to the formulation scientists.The present study has shown that it is possible to increase the dissolution rate of poorly soluble drugs like Aceclofenac, Atorvastatin, Irbesartan, by preparing solid dispersion using Tamarind Seed Polysaccharide a water soluble polymer as solubilizer. Physical mixture and Solid Dispersion of Aceclofenac, Atorvastatin, Irbesartan with Tamarind Seed Polysaccharide (TSP) in ratio of 1:1, 1:3, 1:5 were prepared. Solubility study, Drug content and Dissolution profile study were performed for Aceclofenac, Atorvastatin, Irbesartan in Solid dispersions FS1, FS2, FS3, FS5, FS6, FS7, FS8, FS9 as well as in Physical mixtures FP10, FP11, FP12, FP13, FP14, FP15, FP16, FP17, FP18. It was observed that solid dispersions of each drugs showed increase in dissolution rate in comparision with its pure drug in the ratio of 1:3 (Drug: TSP). The selected formulations of Aceclofenac (FS2), Atorvastatin (FS5), Irbesartan (FS8) with TSP were subjected to Accelerated stability study. The prepared Solid Dispersion Formulations of Aceclofenac, Atorvastatin, Irbesartan using Tamarind Seed Polysaccharide as solubilizer were found to be quite stable. It can be concluded that with the careful and proper use of Tamarind Seed Polysaccharide, solubility of poorly soluble drugs can be improved.

Keywords: Aceclofenac, Atorvastatin, Irbesartan, Tamarind Seed Polysaccharide, (TSP), Solubility, Dissolution

INTRODUCTION

Therapeutic effectiveness of a drug depends upon the bioavailability and ultimately upon the solubility of drug molecules. Solubility behavior of a drug is one of the key determinants of its oral bioavailability. In recent years, the number of poorly soluble drug candidates has increased tremendously. The formulation of poorly soluble drugs for oral delivery presents a challenge to the formulation scientists. The rate and extent of dissolution of the active ingredient from any dosage form often determines the rate of extent of absorption of the drug[1].

The development of novel dosage form of drug delivery systems has resulted in a need for new excipients to support the desired properties. In novel drug delivery systems, polymer plays a vital role. Development of new excipients is time consuming, involves tedious procedures and is highly expensive. Instead, identification of new uses for the existing substances is relatively inexpensive and less time consuming. There has been ever increasing demand for the plant based products as excipients[3]. Natural polymers have advantages over synthetic and semi-synthetic polymers like low cost, natural origin, less side effects, locally available and better patient tolerance. However, these natural substances suffer with the drawbacks like purity, source and microbial contamination. If these factors can be identified and controlled, natural substance can be good substitute for synthetic polymers[5].

Tamarind seed polysaccharide (TSP) is a biodegradable polysaccharide extracted from Tamarind seeds (*Tamarandus indica* Linn. Family; *Leguminosae*) called as TSP has been found to have a wide application in pharmaceutical industry[5]. Tamarind seed polysaccharide (TSP) was evaluated for its suitability as a carrier to improve the dilution rate of Celecoxib, a drug poorly soluble in water. Bioavailability of certain drugs has been significantly improved by the use of Tamarind seed polysaccharide (TSP)[4].

Solid dispersion is one of the most promising approaches for solubility enhancement. More than 60% of potential drug products suffer from poor water solubility, and due to lipophilic nature posing problems in their formulation into delivery system. Experience with solid dispersions over the last 20-30 years indicates that this is a very fruitful approach to improving the release rate and oral bioavailability of poorly water soluble drugs[10].

MATERIALS AND METHODS

Materials

Drugs Aceclofenac, Atorvastatin and Irbesartan received as gift sample. Tamarind Seeds procured from local market. Potassium dihydrogen phosphate, Sodium hydroxide, Disodium hydrogen phosphate, Sodium chloride, n-octanol, distilled water, Ethanol, Methanol, and Acetone, Chloroform, Hydrochloric acid were of analytical grade and procured from SDFCL and HIMEDIA.

Methods

Preparation of Physical Mixture

Physical mixture of Aceclofenac, Atorvastatin, Irbesartan with Tamarind Seed Polysaccharide (TSP) in ratio of 1:1, 1:3, 1:5 were prepared by mixing. All the ingredients were weighed accurately in a predetermined ratio and pulverized by light triturating for 5 minutes in mortar till a homogenous mixture was obtained. This mixture was passed through sieve 80 for uniform size and stored in desiccators for further use[6].

Preparation of Solid Dispersion

Solid Dispersion of Aceclofenac, Atorvastatin, Irbesartan with Tamarind Seed Polysaccharide (TSP) in ratio of 1:1, 1:3, 1:5 were prepared by Cogrinding. All the ingredients were weighed accurately in a predetermined ratio and pulverized by grinding for 30 minutes in mortar and pestle till a homogenous mixture was obtained. This mixture was passed through sieve 80 for uniform size and stored in desiccators for further use[12].

Determination of Equilibrium Solubility of Drugs (Aceclofenac, Atorvastatin, Irbesartan) in formulations

Solubility study was performed according to the method reported by Higuchi and Connors. To evaluate the increase in solubility of Aceclofenac, Atorvastatin, Irbesartan in Solid dispersions FS1, FS2, FS3, FS5, FS6, FS7, FS8, FS9 as well as in Physical mixtures FP1, FP2, FP3, FP4, FP5, FP6, FP7, FP8, FP9. Excess of formulations were added to 25 ml of distilled water taken in a stoppered conical flasks were shaken for 8 hrs at 37+1 ^{o}C 1in incubator shaker. And solutions were kept for 24 hrs. after shaking to achieve equilibrium, 2 ml aliquots were withdrawn and filtered through whatman filter paper. The filtrate was analysed spectrophotometrically[13] at λmax. 275 nm (Aceclofenac), 246.5 nm (Atorvastatin), 244 nm (Irbesartan) against

blank. Readings were taken in triplicate and observations are recorded in table 1, 2, 3.

Dissolution Profile Study of Aceclofenac[1], Atorvastatin[2], Irbesartan[3] Formulations

The dissolution rate testing of different Aceclofenac, Atorvastatin, Irbesartan capsule formulations was studied using USP XXII dissolution rate testing apparatus, at a speed of 50 rpm and the dissolution fluid (900 ml Phosphate buffer pH 7.4 for Aceclofenac and Atorvastatin and 0.1 N HCl for Irbesartan) was maintained at a temperature of 37.50± 0.5 ^{0}C. At specific time intervals, a 5 ml aliquot of dissolved medium was withdrawn and was replaced with fresh quantity of dissolution medium. The samples were suitably diluted with dissolution medium and assayed for Aceclofenac content by measuring the absorbance at 275 nm and for Atorvastatin content at 246.5 nm and for Irbesartan content at 244 nm using U.V Spectrophotometer. Readings were taken in triplicate. Cumulative percentage of the drug dissolved from the formulations was calculated. Observations and results are reported in table

Drug Content Estimation of Aceclofenac[1], Atorvastatin[2], Irbesartan[3] Formulations

Solid dispersions equivalent to 10 mg of Aceclofenac, Atorvastatin, Irbesartan (50 mg) were weighed accurately and dissolved in the 10 ml of methanol and in 50 ml of Ethanol (Irbesartan). The solution was filtered, diluted suitably and drug content was analyzed for Aceclofenac, Atorvastatin and Irbesartan at λmax. 275 nm, 246.5 nm and 244 nm respectively by UV spectrophotometer. Readings were taken in triplicate and observations are recorded.

FTIR Study

Aceclofenac, Atorvastatin, Irbesartan Solid Dispersion were compressed into a pallet along with KBr (KBr pellet technique) using Shimadzu hydraulic press. The FTIR spectrum of samples were recorded in the wave number region of 400-4000 cm^{-1} on a FTIR spectrophotometer (Shimadzu 8300) and presented in fig.7, 8, 9.

Differential Scanning Calorimetry

Differential Scanning Calorimetry analysis was performed with a Mettler TA 4000 apparatus equipped with a DSC 25 cell. Weighed samples (5 – 10 mg, Mettler M3 microbalance) were scanned in pierced aluminium pans under static air at a scan rate of 10 ^{0}C min^{-1} over a 30 – 200 ^{0}C temperature range. The instrument is calibrated for temperature and heat flow using Indium as a standard[14].

X - ray Diffraction Study

The powder X-ray diffraction spectra of prepared solid dispersions were obtained using RU-H3R, Horizontal Rotaflex rotating anode X-ray generator instrument, Rigaku (Rigaku International Corporation, Tokyo). The sample was spread on a graticule and pressed in such a way that sample did not fall on keeping the graticule in vertical position. The graticule was placed in sample holder and exposed to CuKα_-radiation (40 KV, 50 MA), 2θ= 5^0 to 50^0 at a scanning speed 3^0/min and step size 0.04^0 2θ[14].

Stability study

The selected formulations of Aceclofenac (FS2), Atorvastatin (FS5), Irbesartan (FS8) with TSP were subjected to Accelerated stability study as per ICH guidelines at different temperature conditions such as room temperature (25^{0}C) and at 40±2^{0}C/75±5 % RH for a period of 3 months.

RESULTS AND DISCUSSION

Optimization of solid dispersion

Equilibrium Solubility Study of Aceclofenac in Different Formulation such as FS1, FS2, FS3, FP1, FP2, FP3 and pure Aceclofenac was performed. Result indicates that solubility enhancement percentage is best in case of formulation FS2 which is in the ratio of 1:3, when compared with pure drug. Order of Solubility enhancement, FS2>FS3>FS1> FP2>FP3>FP1>Pure Aceclofenac.

Table 1: Equilibrium Solubility Study of Aceclofenac Formulations

S. No.	Formulation code	Equilibrium solubility (µg/ ml at 37+1 ^{0}C in Water)	Percentage Solubility Enhancement (%)
1	Pure Aceclofenac	0.074	
2.	FS1	13.97	188.78
3.	FS2	19.22	259.72
4.	FS3	17.98	240.97
5.	FP1	7.28	98.37
6.	FP2	11.61	156.89
7.	FP3	10.89	143.16

Table 2: Equilibrium Solubility Study of Atorvastatin Formulations

S. No.	Formulation code	Equilibrium solubility (µg/ ml at 37+1 ^{0}C in Water)	Percentage Solubility Enhancement (%)
1	Pure Atorvastatin	0.069	
2.	FS4	14.12	204.63
3.	FS5	20.03	290.89
4.	FS6	18.98	275.07
5.	FP4	9.18	133.04
6.	FP5	15.16	219.71
7.	FP6	14.99	210.46

Equilibrium Solubility Study of Atorvastatin in Different Formulation such as FS4, FS5, FS6, FP4, FP5, FP6 and pure Atorvastatin was performed. Result indicates that solubility enhancement percentage was best in case of formulation FS5 which is in the ratio of 1:3, when compared with pure drug. Order of Solubility enhancement, FS5>FS6>FS4>FP5> FP6>FP4>Pure Atorvastatin.

Table 3: Equilibrium Solubility Study of Irbesartan Formulations

S. No.	Formulation code	Equilibrium solubility (µg/ ml at 37+1 ^{0}C in Water)	Percentage Solubility Enhancement (%)
1	Pure Irbesartan	0.058	
2.	FS7	12.65	218.10
3.	FS8	16.12	277.93
4.	FS9	15.48	256.89
5.	FP7	6.91	119.13
6.	FP8	9.12	157.24
7.	FP9	8.88	143.10

Equilibrium Solubility Study of Irbesartan in Different Formulation such as FS7, FS8, FS9, FP7, FP8, FP9 and pure Irbesartan was performed. Result indicates that solubility enhancement percentage was best in case of formulation FS8 which is in the ratio of 1:3, when compared with pure drug. Order of Solubility Enhancement, FS8>FS9>FS7> FP8>FP9>FP7.

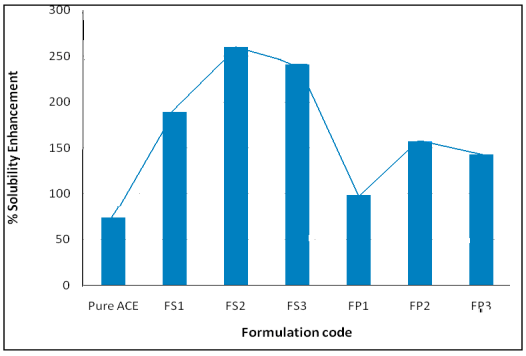

Fig. 1: Equilibrium Solubility Study of Aceclofenac in Different Formulation

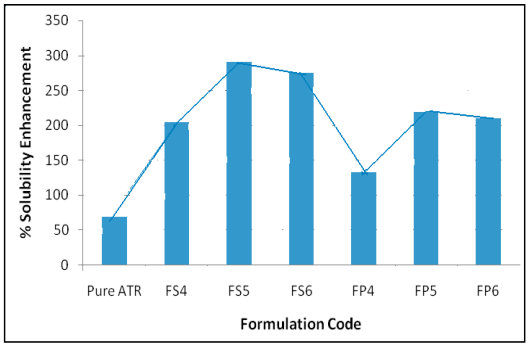

Fig. 2: Equilibrium Solubility Study of Atorvastatin in Different Formulation

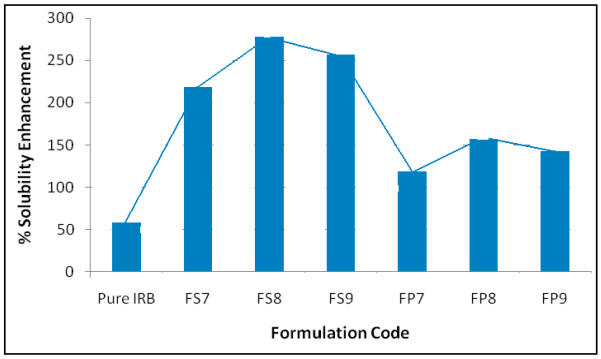

Fig. 3: Equilibrium Solubility Study of Irbesartan in Different Formulation

Table 4: Dissolution profile of Aceclofenac formulations

Time (min)	Pure drug	FS1	FS2	FS3	FP1	FP2	FP3
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	2.65	6.96	9.92	8.09	4.36	5.09	5.16
20	5.81	16.86	25.12	21.95	10.36	14.82	12.93
30	12.12	29.36	42.23	37.45	18.19	25.93	23.65
40	19.45	41.75	55.46	50.65	31.64	38.14	35.88
50	25.29	63.96	77.44	73.86	44.52	55.28	50.99
60	30.96	80.99	96.87	89.89	51.56	72.86	67.96

Solid dispersion of Aceclofenac showed significant increase in the dissolution rate as compared with pure Aceclofenac. The amount of pure drug dissolved after one hour was 30.96 %, while for solid dispersion with TSP (1:1) it was 80.99 % and for Solid Dispersion with TSP (1:3) it was 96.87 % and for Solid Dispersion with TSP (1:5) it was 89.89 %. For Physical Mixture with TSP (1:1) it was 51.56 % and for Physical Mixture with TSP (1:3) it was 72.86 % and for Physical Mixture with TSP (1:5) it was 67.96 %. All the physical mixtures and solid dispersions showed improved dissolution over pure Aceclofenac.

Table 5: Dissolution profile of Atorvastatin formulations

Time (min)	Pure drug	FS4	FS5	FS6	FP4	FP5	FP6
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	3.12	8.36	9.97	9.01	4.97	6.89	6.05
20	7.85	18.23	26.36	21.65	10.36	15.22	13.93
30	12.96	32.08	40.56	37.45	18.42	25.63	21.91
40	19.59	43.39	55.91	50.55	29.34	39.14	34.18
50	25.92	60.10	78.15	71.84	44.52	56.45	51.99
60	31.09	74.25	98.96	91.58	52.54	71.03	67.46

Solid dispersion of Atorvastatin showed significant increase in the dissolution rate as compared with pure Atorvastatin. The amount of pure drug dissolved after one hour was 31.09 %, while for solid dispersion with TSP (1:1) it was 74.25 % and for Solid Dispersion with TSP (1:3) it was 98.96 % and for Solid Dispersion with TSP (1:5) it was 91.58 %. For Physical Mixture with TSP (1:1) it was 52.54 % and for Physical Mixture with TSP (1:3) it was 71.03 % and for Physical Mixture with TSP (1:5) it was 67.46 %. All the physical mixtures and solid dispersions showed improved dissolution over pure Atorvastatin.

Table 6: Dissolution Profile of Irbesartan formulations

Time (min)	Pure drug	FS7	FS8	FS9	FP7	FP8	FP9
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	2.05	7.16	9.12	8.95	5.09	6.12	5.48
20	6.85	16.89	22.36	19.65	11.36	15.82	13.93
30	12.76	31.08	41.03	37.45	20.19	26.63	22.51
40	19.89	46.33	56.98	50.36	31.64	39.14	35.88
50	26.92	63.01	78.15	71.56	42.52	53.12	50.99
60	30.12	80.65	97.96	91.58	55.56	74.56	69.96

Solid dispersion of Irbesartan showed significant increase in the dissolution rate as compared with pure Irbesartan. The amount of pure drug dissolved after one hour was 30.12 %, while for solid dispersion with TSP (1:1) it was 80.65 % and for Solid Dispersion with TSP (1:3) it was 97.96 % and for Solid Dispersion with TSP (1:5) it was 91.58 %. For Physical Mixture with TSP (1:1) it was 55.56 % and for Physical Mixture with TSP (1:3) it was 74.56 % and for Physical Mixture with TSP (1:5) it was 69.96 %. All the physical mixtures and solid dispersions showed improved dissolution over pure Irbesartan.

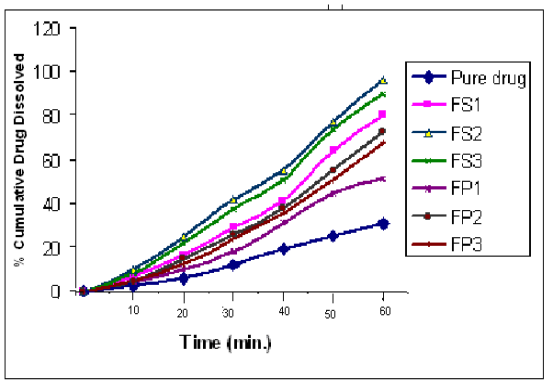

Fig. 4: Percent Cumulative release of Aceclofenac from its formulations

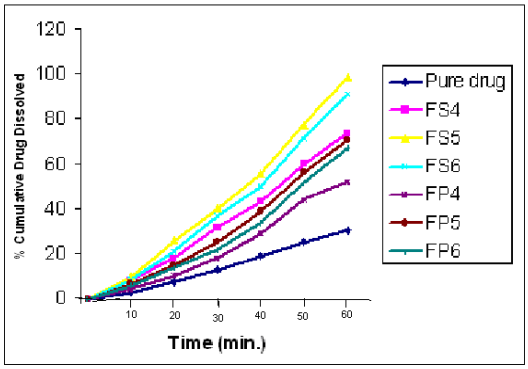

Fig. 5: Percent Cumulative release of Atorvastatin from its formulations

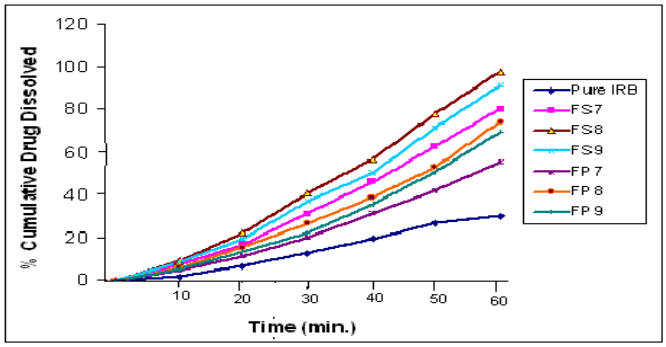

Fig. 6: Percent Cumulative release of Irbesartan from its formulations

So above study shows that dissolution rate of all three poorly soluble drug significantly increases in the ratio of 1:3 (Drug:TSP). This might give an idea about the quantity of TSP that can be used as solubilizer in pharmaceutical preparations.

Characterization of Solid Dispersion

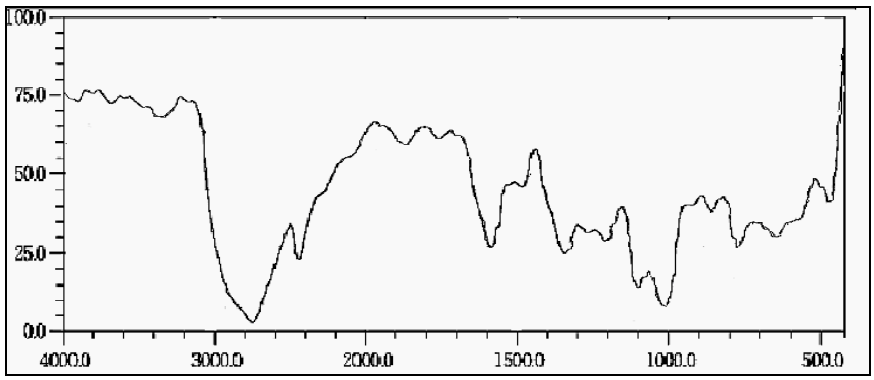

Fig. 7: FTIR spectra of Formulation FS2 Solid Dispersion of ACE

The FTIR spectra of pure Aceclofenac and its solid dispersion (FS2) shown in Fig. 9.1. The FTIR spectra of pure Aceclofenac discussed in table No. 6.11 showed characteristic peaks at 3319- 3267 cm^{-1} (OH alcoholic group), 2970 cm^{-1} (Aromatic NH stretching), 2937,1921 cm^{-1} (CH Streching and CH_2, 1770-1716 cm^{-1} (C=O), 1589,1577,1508 cm^{-1} (C=C Ring Streching). It might be the possibility of intermolecular hydrogen bonding between adjunct Aceclofenac molecules. The spectrum of pure Aceclofenac is equivalent to the spectra obtained by the addition of TSP. This indicates that no interaction occurred in solid dispersion of drug with TSP. The results revealed no considerable changes in the IR peaks of Aceclofenac, when mixed with TSP.

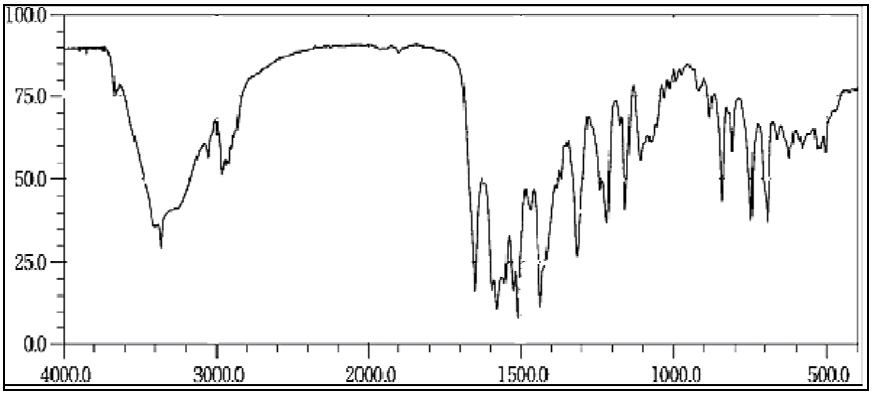

Fig. 8: FTIR spectra of Formulation FS5 Solid Dispersion of ATR

The FTIR spectra of pure Atorvastatin and its solid dispersion (FS5) shown in Fig. 8. The FTIR spectra of pure Atorvastatin showed characteristic peaks at 2955.15 cm^{-1} (C-H stretching), 1313.56 cm^{1}(C-N stretching), 3059.15 cm^{-1} (C-OH stretching alcoholic group), 1564.97 cm^{-1} (C=O stretching amidic group), 3403.27 cm^{-1} (N-H stretching), 1656.97 cm^{-1} (C=C bending), 751.62 cm^{-1} , 696.95 cm^{-1} (C-F stretching), 1104.39 cm^{-1} (O-H bending). It might be the possibility of intermolecular hydrogen bonding between adjunct Atorvastatin molecules. The spectrum of pure Atorvastatin is equivalent to the spectra obtained by the addition of TSP. This indicates that no interaction occurred in solid dispersion of drug with TSP. The results revealed no considerable changes in the IR peaks of Atorvastatin, when mixed with TSP.

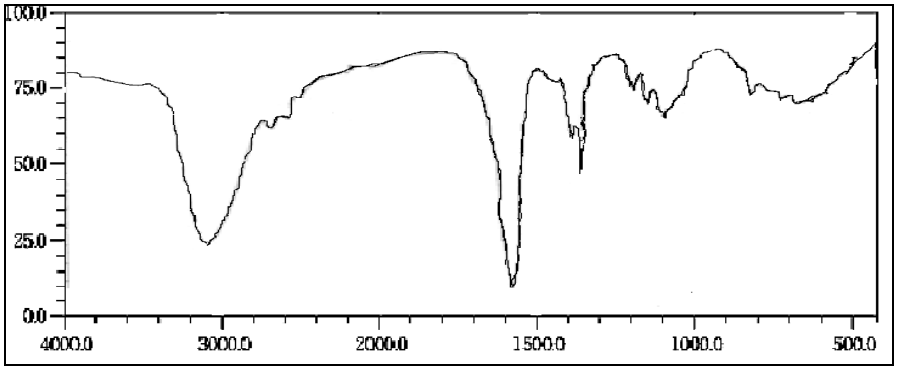

Fig. 9: FTIR spectra of Formulation FS8 Solid Dispersion of IRB

The FTIR spectra of pure Irbesartan and its solid dispersion (FS8) shown in Fig. 9. The FTIR spectra of pure Irbesartan showed characteristic peaks at 3441 cm^{-1} (N-H stretch), 3131,3057 cm^{-1} (Aromatic C–H stretch), 2959, 2934, 2870, 2664, 2359 cm^{-1}(Aliphatic C-H stretch) 1732 cm^{-1} (C = O stretch), 1620 cm^{-1} and 1533 cm^{-1} (Aromatic C=C Bend and Stretch), 1441 and 1414 cm^{-1} (C–N amide stretch), 1358 & 1341 cm^{-1} (C=O ketone) 746 cm^{-1} (ring vibration due to 1,2-disubstituted benzene), respectively. It might be the possibility of intermolecular hydrogen bonding between adjunct Irbesartan molecules. The spectrum of pure Irbesartan is equivalent to the spectra obtained by the addition of TSP. This indicates that no interaction occurred in solid dispersion of drug and TSP. The results revealed no considerable changes in the IR peaks of Irbesartan, when mixed with TSP.

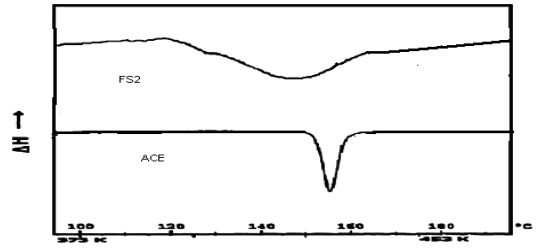

Fig. 10: DSC of Formulation FS2 Solid Dispersion of ACE

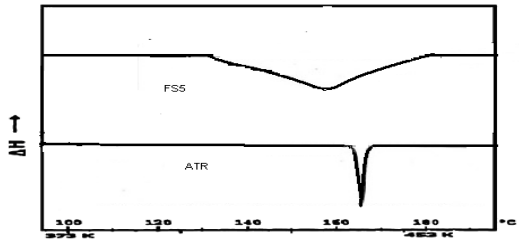

Fig. 11: DSC of Formulation FS5 Solid Dispersion of ATR

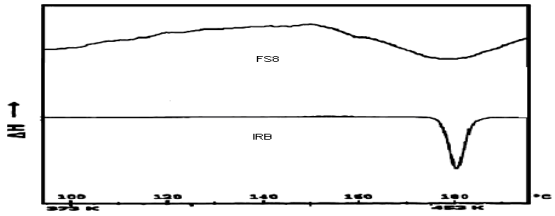

Fig. 12: DSC of Formulation FS8 Solid Dispersion of IRB

DSC study was performed to study any possible drug polymer interaction. Fig 10, 11, 12 represents DSC of formulations FS2, FS5, FS8 assigned for Aceclofenac, Atorvastatin, Irbesartan respectively. Fig. 10 exhibits a sharp endothermic peak at 156 °C which corresponds to Aceclofenac melting point (150 -156 ºC). The Aceclofenac+TSP that is Formulation FS2 exhibit a sharp endothermic peak at 154ºC. Fig. 11, exhibits a sharp endothermic peak at 164 °C which corresponds to Atorvastatin melting point (159-165ºC). The Atorvastatin+TSP that is Formulation FS5 exhibit a sharp endothermic peak at 160ºC. Fig.12 exhibits a sharp endothermic peak at 180 °C which corresponds to Irbesartan melting point (160-182 ºC). The Irbesartan + TSP that is Formulation FS8 exhibit a sharp endothermic peak at 178ºC. Hence DSC study showed that there was no any drug polymer interaction.

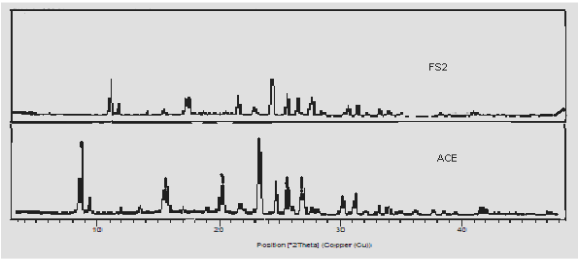

Fig. 13: X-ray Diffraction of Formulation FS2 Solid Dispersion of ACE

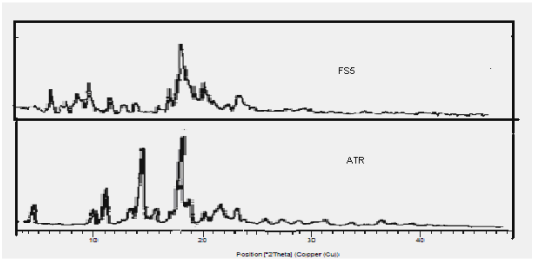

Fig. 14: X-ray Diffraction of Formulation FS5 Solid Dispersion of ATR

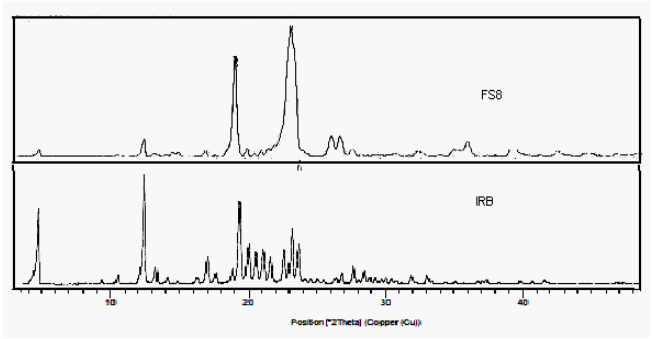

Fig. 15: X-ray Diffraction of Formulation FS8 Solid Dispersion of IRB

X-ray diffraction patterns of fig. 13, 14, 15 revealed that pure drugs were in crystalline state as it showed sharp distinct peaks notably at 2Q diffraction angles of 12.98^0, 17.02^0, 21.65^0, 25.13^0, 26.17^0, 26.88^0, 27.56^0 and at 13.53^0, 25.88^0, 28.97^0, 32.21^0, 33.86^0 and at 4.75^0, 12.49^0, 19.45^0, 23.18^0 for Aceclofenac, Atorvastatin, Irbesartan respectively. The reflections (specific peaks) corresponding to the drug and TSP were also found in the formulation diffractogram with reduced intensity as compared to drug alone. The reduction in intensity and number of typical diffraction peaks in formulation diffractogram suggests reduction in crystalline nature of drug and may be converted from crystalline to amorphous form.

Stability Studies

- The selected formulations of Aceclofenac, Atorvastatin, Irbesartan with TSP were subjected to Accelerated stability study. Physical stability studies at different temperature conditions such as room temperature (25^{0}C) and at 40±2^{0}C/75±5 % RH for a period of 3 months. From the Physical Stability studies, it was observed that Solid Dispersion formulations FS2, FS5, FS8 show no liquification, no caking, and no color change for 90 days at room temperature. The formulations FS2, FS5, FS8 showed no caking for 45 days and 75 days at 40±2^{0}C/75±5 % RH, but slight caking during 90 days. This indicates that formulations are physically stable.

- The results of chemical stability studies showed that the % Drug Content at the end of 90 days were not showed any significant change during stability studies that is these limits are within the acceptable range, shows that formulations are chemically stable. The % Drug Content at 90 days time period in formulation FS2 was 98.58 % at room temperature and 98.16 % at 40±2^{0}C/75±5 % RH and in formulation FS5 it was 98.21 % at room temperature and 97.94 % at 40±2^{0}C/75±5 % RH and in formulation FS8 it was 97.96 % at room temperature and 97.16 % at 40±2^{0}C/75±5 % RH. This study indicates that formulations are stable.

- The results of chemical stability shows that the % Cumulative Drug release in all the three formulations that is FS2, FS5, FS8 at the end of 90 days were not showed any significant change during chemical stability studies. The % Cumulative Drug release at 90 days time period in formulation FS2 was 96.12% at room temperature and 96.21 % at 40±2^{0}C/75±5 % RH and in formulation FS5 it was 98.66 % at room temperature and 98.86 % at 40±2^{0}C/75±5 % RH and in formulation FS8 it was 97.16 % at room temperature and 97.94 % at 40±2^{0}C/75±5 % RH. This study indicates that formulations are stable.

Table 7: Percent Drug Content Data for Chemical Stability of Solid Dispersion

Time (Days)	Percent Drug Content					
	Room temperature (25 ^{0}C)			40±2^{0}C/75±5 % RH		
	FS2	FS5	FS8	FS2	FS5	FS8
0	100.00	100.00	100.00	100.00	100.00	100.00
15	-	-	-	99.08	98.69	98.31
30	99.01	98.66	98.21	98.93	98.51	98.17
45	-	-	-	98.74	98.25	97.92
60	98.89	98.51	98.14	98.69	98.18	97.76
75	-	-	-	98.44	98.03	97.48
90	98.58	98.21	97.96	98.16	97.94	97.16

Table 8: In-Vitro Dissolution Data for Chemical Stability of Solid Dispersion

Time (Days)	Percent Cumulative Drug Release					
	Room temperature (25 ^{0}C)			40±2^{0}C/75±5 % RH		
	FS2	FS5	FS8	FS2	FS5	FS8
0	96.87	98.96	97.96	96.87	98.96	97.96
15	96.81	98.93	97.91	96.86	98.94	97.89
30	96.69	98.84	97.88	96.79	98.88	97.91
45	96.46	98.91	97.81	96.71	98.91	97.75
60	96.74	98.76	97.05	96.82	98.81	97.82
75	96.56	98.51	97.34	96.77	98.73	97.88
90	96.12	98.66	97.16	96.21	98.86	97.94

CONCLUSION

The prepared Solid Dispersion Formulations of Aceclofenac, Atorvastatin, Irbesartan using Tamarind Seed Polysaccharide as solubilizer, showed improved solubility and dissolution characteristics as compared with the pure drug and also found quite stable.

- The proposed solubilizer Tamarind Seed Polysaccharide is safe hence; toxicities/safety related issues will not arise as it is herbal polymer and does not have side effects.
- All these features of polymer (TSP) suggesting its adaptability for large scale manufacturing that is industrial feasibility.
- The proposed polymer is herbal and readily available at low cost so it will generate revenue for country as well as profit for companies.
- The proposed technique would be economical, convenient and safe. Thus it will open chances for preparing formulations with poorly soluble drugs with improved solubility and dissolution profile.
- It can be concluded that with the careful and proper use of Tamarind Seed Polysaccharide, solubility of poorly soluble drugs can be improved. After the results of this experimental work it would not be surprising that many types of solid dispersions containing **Tamarind Seed Polysaccharide as solubilizer** for poorly soluble drug would enter in the market.

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REFERENCES

1. Arunachalam A., Karthikeyan M, Kishore K., Sethuraman S., Ashutoshkumar S. "Solid Dispersion : An Overview" Current Pharma Research; Volume 1, Issue 1, October- December 2010.
2. Win Laung Chiou, Sidney Riegelman "Pharmaceutical Applications of Solid Dispersion Systems" Journal of Pharmaceutical Sciences ; Volume 60 Number 9. September 1971
3. Phani kumar G.K., Gangarao Battu, Kotha N.S., Lova Raju " Isolation and Evaluation of Tamarind Seed Polysaccharide being used as Polymer in Pharmaceutical Dosage Forms"; Research Journal Of Pharmaceutical, Biological and Chemical Sciences; ISSN: 0975-8585.
4. Rao PS, Ghosh TP, Krishna S. "Extraction and purification of Tamarind seed powder". J Sci Ind Res. 1946; 4: 705.
5. Mounika.S, Narayanan.V , Sarath Chandiran.I, Manasa.V, Sushma.S, Mahita .T, Pavani .D " Pharmaceutical View of Tamarind Gum" ; The Pharma Professionals Volume 1 – Issue 2 : May - August 2011
6. M. Santhosh Aruna, A. Kishore Babu, Madhurilatha Thadanki, M. Eswara Gupta "Solid Dispersion – An Approach to enhance the Dissolution rate of Irbesartan" ; International Journal of research in Pharmacy and Chemistry; IJPRC 2011, 1(4); ISSN: 2231 – 2781
7. Bobe KR, Subrahmanya C R, Suresh Sarasija, Patil M D, Khade T S" Formulation and Evaluation of Solid Dispersion of Atorvastatin with various carriers"; International Journal of Comprehensive Pharmacy; IJCP 2011,1(02); ISSN0976-8157.
8. Aleem M. A., Dehghan M.H., Babu Rajesh " Solid Dispersion – An Approach to Enhance the Dissolution Rate of Aceclofenac by using 3^2 Factorial Design"; International Journal Pharmaceutical Science and Research; IJPSR, 2010; Vol 1(12) 203 – 208; ISSN0975-8232.
9. Uddin Riaz, Ali Farzana, Bsiwas Subrata Kumar "Water Solubility Enhancement of Atorvastatin By Solid Dispersion Method"; Stamford Journal of Pharmaceutical Sciences; S. J. Pharm. Sci. 3(2);43 – 46
10. K Patidar, M D Kshirsagar, V Saini , P B Joshi, M Soni "Solid Dispersion Technology: A Boon for Poor Water Soluble Drugs" Indian Journal of Novel Drug delivery 3(2); Apr-Jun 2011; 83-90.
11. Wadke DA, Serajuddin A, Jacobson H,"Preformulation testing". In: Lieberman HA, Lachman L, Schwartz JB, eds. Pharmaceutical Dosage Forms: Tablets. New York , NY **:** Marcel Dekker; 1989; 1-73.
12. Watano S. "Solubility enhancement of poorly soluble drugs by Cogrinding in the Micros" Nara Machinery Co., Ltd., Tokyo/J
13. Kumar Ashwini G., Choudhary Ram Kumar, Chaitanya CH. "Enhancement of Solubility and Dissolution Rate of Irbesartan by Solid Dispersion Technique"Asian Journal of Pharmaceutical and Clinical Research; Vol. 4, Issue 2, 2011 ISSN - 0974-2441.
14. Meka Anand Kumar, Pola Santhosh, Reddy Karnaker, Prasanna Lakshmi "Development, Evaluation and Characterization of surface solid dispersion for solubility and dissolution enhancement of Irbesartan" International Journal of Drug Development & Research; January-March 2012 ; Vol. 4; Issue1 ; ISSN 0975-9344.