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ENHANCEMENT OF ZALTOPROFEN SOLUBILITY IN FAST DISSOLVING TABLETS VIA SOLID DISPERSION TECHNIQUES USING VARIOUS CARRIERS

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ABSTRACT

Solubility is critical for attaining the intended drug concentration in systemic circulation, especially for lipophilic drugs with poor water solubility like Zaltoprofen, a class II BCS medication with very low bioavailability. This study aimed to create a solid dispersion (SD) of Zaltoprofen to improve its dissolution rate and formulate a fast-dissolving tablet using hydrophilic carriers. Solid dispersions were prepared via physical mixture, kneading, solvent evaporation, and fusion methods with carriers such as urea, mannitol, β-cyclodextrin, PEG 6000, PVP K30, and Poloxamer 188 in various ratios (1:2, 1:4, 1:6). Tablets were formulated using direct compression method. Pure Zaltoprofen showed a water solubility of 0.013±0.04 mg/ml. Solid dispersion solubility, drug content, and *in vitro* dissolution tests showed positive results, with the best solid dispersion used for tablet formulation. Post-compressional studies indicated good hardness, friability, and rapid disintegration times. Formulation F2 showed the highest stability under accelerated conditions and improved *in vitro* release compared to the pure drug. The findings conclude that Zaltoprofen's solubility and dissolution rate can be significantly enhanced using solid dispersion techniques with appropriate hydrophilic carriers.

Keywords: Zaltoprofen; enhanced solubility; solid dispersion; fast dissolving tablets

INTRODUCTION

Solubility plays a significant role in achieving the correct drug concentration in the bloodstream and demonstrating a pharmacological response. When taken orally, poorly soluble medications may need high doses to achieve therapeutic plasma concentrations. About 40% of the marketed drugs and about 90% of the new molecules

are facing problems with water solubility **[1]**.

Solid dispersions are among the most effective methods for enhancing the drug release of weakly soluble medicines, however other techniques have also been employed to increase the water solubility **[2]**. In the biopharmaceutical classification system (BCS), solubility is one of the most important criteria, and the primary factor affecting a drug's bioavailability is its dissolution rate **[3, 4]**. A series of dosage forms known as "solid dispersions" are used to describe a method of dispersing pharmaceuticals in a physiologically inert matrix, typically with the goal of improving oral bioavailability **[5-7]**.

Therefore, in order to boost the solubility of Zaltoprofen, we are employing solubility enhancement techniques by solid dispersion methods in this work.

MATERIALS AND METHODS

Materials

The supplier of Zaltoprofen was Yarrow Chem Products Pvt. Ltd. in Mumbai. Karnataka Fine Chemicals in Bangalore purchased the Poloxamer 188, mannitol and urea. PEG and β-cyclodextrin were purchased from Mumbai's Himedia Laboratories. PVP K 30, methanol magnesium stearate, lactose and acetone obtained from SD Fine Chemicals in Mumbai. **Method**

FTIR compatibility studies

Before starting formulation, it is important to make sure that the drug and polymer are compatible in experimental settings. Verifying that the medication doesn't react with the polymer or excipients. Using the potassium bromide disc (pellet) method, the infrared (IR) tests have been performed on the drug and polymers that were obtained **[8]**.

Standard plot of zaltoprofen

Pipette the standard stock solution in intervals of 0.2,0.4,0.6,0.8,1.0 ml into 10ml volumetric flask. After adding 6.8 phosphate buffer to the appropriate proportions, the mixture produced solutions with concentrations of the drug in 2, 4, 6, 8, and 10 µg/ml. The absorbance of these resultant solutions was measured at 243.5nm using 6.8 phosphate buffer as reference. Plotting the observed absorbance against the matching concentration (µg/ml) was done.

Preparation of solid dispersions of zaltoprofen

Solid dispersions of Zaltoprofen and carrier (Urea Mannitol, PVP K30, PEG 6000, β cyclodextrin, Poloxamer 188) were prepared in different ratios by Physical mixture, Kneading, Solvent evaporation and Fusion methods.

Physical mixture

Physical mixture of Zaltoprofen with different polymers (Urea Mannitol, PEG 6000, βcyclodextrin, PVP K30, Poloxamer 188) prepared by combining them in a

mortar and pestle in different ratios of 1:2, 1:4, and 1:6 **[9]**.

Kneading method

In this method required amount of Zaltoprofen and polymers (Urea Mannitol, PEG 6000, βcyclodextrin, PVP K30, Poloxamer 188) in various ratios (1:2,1:4, and 1:6 w/w) were taken and transfer into a mortar and pestle. The mixture is size reduced by continuously stirring the pestle, acetone was added to the above mixture and continuously stir until slurry mass was obtained. Slurry mass collected and dried in a hot air oven at 50°C for 60min. Dried mass is collected and pass through sieve and stored in a desicator **[10]**.

Solvent evaporation

In this method required quantity of Zaltoprofen and polymers (Urea Mannitol, PEG 6000, βcyclodextrin, PVP K30, Poloxamer 188) in different ratios (1:2,1:4, and 1:6 w/w) was dissolved in sufficient amount of methanol: acetone (1:1) ratio in a china dish. To obtain a dry mass, the solvent from the solution is removed at 45°C while stirring continuously. After being sieved, the dry mass is stored in a desiccator **[11]**.

Fusion method

The required quantity of polymers (Urea Mannitol, PEG 6000, βcyclodextrin, PVP K30, Poloxamer 188) in different ratios (1:2,1:4, and 1:6 w/w) was taken in a china dish and it was heated in a heating mantle. The carrier is heated to melt and required amount of Zaltoprofen was incorporated in a molten carrier. Then it was cooled and solidified by placed over a ice Finally solid mass is pulverized and pass through the sieve and stored in a desicator **[12]**.

Table 1: Composition of Solid dispersions

Composition	Method	Formulation code	Ratio
Drug +urea	Physical mixture	UP_1 UP_2 UP_3	1:2 1:4 1:6
Drug +Mannitol	Physical mixture	MP_4 MP_5 MP_6	1:2 1:4 1:6
Drug +β cyclodextrin	Physical mixture	CP_7 CP_8 CP_9	1:2 1:4 1:6
Drug +PEG 6000	Physical mixture	PP_{10} PP_{11} PP_{12}	1:2 1:4 1:6
Drug +PVP-K-30	Physical mixture	VP_{13} VP_{14} VP_{15}	1:2 1:4 1:6
Drug +Polaxamer	Physical mixture	LP_{16} LP_{17} LP_{18}	1:2 1:4 1:6
Drug +urea	Kneading method	UK_{19} UK_{20} UK_{21}	1:2 1:4 1:6
Drug +Mannitol	Kneading method	MK_{22} MK_{23} MK_{24}	1:2 1:4 1:6
Drug +β cyclodextrin	Kneading method	CK_{25} CK_{26} CK_{27}	1:2 1:4 1:6

Composition	Method	Formulation code	Ratio
Drug +PEG 6000	Kneading method	PK_{28} PK_{29} PK_{30}	1.2 1.4 1.6
Drug +PVP-K-30	Kneading method	VK_{31} VK_{32} VK_{33}	1:2 1:4 1:6
Drug +Polaxamer	Kneading method	LK_{34} LK_{35} LK_{36}	1:2 1:4 1:6
Drug +urea	Solvent evaporation	US_{37} US_{38} US_{39}	1:2 1:4 1:6
Drug +Mannitol	Solvent evaporation	MS_{40} MS_{41} MS_{42}	1:2 1:4 1:6
Drug +β cyclodextrin	Solvent evaporation	CS_{43} CS_{44} CS_{45}	1:2 1:4 1:6
Drug +PEG 6000	Solvent evaporation	PS_{46} PS_{47} PS_{48}	1.2 1.4 1.6
Drug +PVP-K-30	Solvent evaporation	VS_{49} VS_{50} VS_{51}	1:2 1:4 1:6
Drug +Polaxamer	Solvent evaporation	LS_{52} LS_{53} LS_{54}	1:2 1:4 1:6
Drug +urea	Fusion method	UF_{55} UF_{56} UF_{57}	1:2 1:4 1:6
Drug +Mannitol	Fusion method	MF_{58} MF_{59} MF_{60}	1:2 1:4 1:6
Drug +β cyclodextrin	Fusion method	CF_{61} CF_{62} CF_{63}	1:2 1:4 1:6
Drug +PEG 6000	Fusion method	PF_{64} PF_{65} PF_{66}	1:2 1:4 1:6
Drug +PVP-K-30	Fusion method	VF_{67} VF_{68} VF_{69}	1.2 1.4 1.6
Drug +Polaxamer	Fusion method	LF_{70} LF_{71} LF_{72}	1:2 1:4 1:6

CHARACTERIZATION OF SOLID DISPERSION

Percent practical yield

The practical yield (%) was calculated in order to get the percentage yield or efficiency. Solid dispersion was collected and weighed, to determine the practical yield (PY) from the following equation **[13]**.

Percent practical yield (%) = [Practical Mass (Solid dispersion) / Theoretical Mass (Drug + Carrier)] × 100

Solubility studies of zaltoprofen solid dispersion

Determination of solubility of Zaltoprofen, an excess of drug was mixed with 10 ml of water in beaker and maintained at 25°C and were shaken continuously in a magnetic stirrer at constant temperature. A time period of 24 hours was found sufficient for the attainment of equilibrium. The saturated solutions were filtered and diluted suitably.

Absorbance of diluted Zaltoprofen solutions was determined at 243.5nm using UV absorption spectrophotometer **[14]**.

Drug content

A weighted quantity of Solid Dispersion (equal to 10 mg of Zaltoprofen) was taken and dissolved in 100 ml of 6.8 phosphate buffer using a UV absorption spectrophotometer. The drug content was then measured at 243.5 nm by diluting 1 ml of the solution to 10 ml. Equation below was used to compute the drug content.

$$\%\text{Drug content} = \frac{\text{pratical zaltoprofencontent in weighed quantity of drug carrier mixture}}{\text{Theoritical amount of zaltoprofen in drug carrier mixture}} \times 100$$

***In vitro* dissolution studies**

An in vitro dissolution study was conducted using 900 ml of 6.8 phosphate buffer at 37±0.2°C with USP Type I (Basket) apparatus. Zaltoprofen solid dispersion (80 mg) were tested at 50 rpm for 120 minutes. Samples were taken every 15 minutes, filtered, diluted, and analyzed using a UV spectrophotometer at 243.5 nm **[15]**.

FORMULATION OF FAST DISSOLVING TABLETS

At first, the required ingredients were weighed in a balance, then the excipients were sieved through appropriate sieve. All the ingredients were mixed properly by taking in an airtight plastic bag. The prepared blend was directly subjected for compression in a rotary tablet compression machine. After compression, tablets were evaluated for post compressional parameters.

Table 2: Formulation of Zaltoprofen fast dissolving tablets

S. No.	Ingredients	F_1 (mg)	F_2(mg)
1	Pure drug	80	-
2	Solid dispersion (LP18/ LK36/ LS54/LF72)	-	560
3	Sodium starch Glycolate	15	15
4	Lactose	493	13
5	Magnesium stearate	6	6
6	Talc	6	6
	Total weight	600	600

EVALUATION OF PREPARED TABLETS

PRE-COMPRESSION STUDIES

Angle of repose

It is the maximum angle that can be formed between the powder pile's surface and the horizontal plane. The fixed height funnel standing method was used to measure it.

Bulk density and tapped density

The apparent bulk density (BD) and tapped density (TD) were determined using 10 gm of the bulk powder from each tablet

formulation.BD and TD was calculated using the following equations:

$$Bulkdensity = \frac{Weight\ of\ granules\ blend}{Bulk\ volume}$$

$$Tappeddensity = \frac{weight\ of\ granules\ blend}{Tapped\ volume}$$

Carr's index/ compressibility index

Carr's compressibility index was used to determine the powder blend's compressibility index.

The following is the formula for Carr's Index:

$$Carr'sindex = \frac{Tappeddensity - Bulkdensity}{Tappeddensity} \times 100\%$$

Hausner's ratio

The following equation was used to determine Hausner's Ratio:

$$Hausner'sratio = \frac{Tappeddensity}{Bulkdensity}$$

POST-COMPRESSION PARAMETERS

Uniformity of thickness

The tablets' thickness was measured by using the Vernier caliper. Three tablets were selected at random for each formulation, the dimensions were measured in millimeters and the standard deviation was calculated.

Weight variation test

lists the weight variation and percentage deviation criteria for the Indian Pharmacopoeia. The drug's weight variation was determined using an analytical weighing scale. Ten tablets were selected at random and weighed individually from each batch. The average and standard deviation were calculated after that:

Hardness test

Using a Monsanto hardness tester, the resulting tablets' hardness was determined. For each batch, three tablets were selected at random, and the hardness was expressed in kg/cm^2. Calculations were also done for the mean and standard deviation.

Friability test

The friability test was conducted using a Roche friabilator. After 10 tablets of each formulation were placed in the friabilator, it was carefully weighed (initial wt) and rotated for 4 min at 25 rpm. The tablets were weighed once again (final wt), and a formula was used to determine the percentage of weight loss in each medication.

% Friability = {(Initial wt-Final wt)/Initial wt} ×100

***In-vitro* disintegration test**

To test the disintegration of the manufactured tablets, one tablet was placed in each tube of the basket, and a disc was dropped onto the tablet. The immersion liquid used to run the disintegration equipment was simulated intestinal fluid that was kept at 37±0.5℃. The time required for the tablet to completely dissolve and leave no mass inside the device was timed and noted. Each formulation had a triplicate run of the experiment.

***In vitro* drug dissolution**

In vitro drug release was conducted using a USP Type II paddle apparatus with 900 ml of 6.8 phosphate buffer at 37±0.5ºC and 50 rpm. Samples were taken at each 5 miniutes intervals up to 60 minutes, filtered, diluted,

and analyzed using a UV spectrophotometer at 243.5 nm. Cumulative drug release was calculated **[16-17]**.

Drug kinetic release

The obtained data was fitted into Higuchi's zero order, first order, and Korsmeyer-Peppas models in order to investigate the drug release mechanism and the release rate kinetics of the dosage form. Consequently, it was possible to compare the R2 values and choose the best-fit model **[18]**.

RESULTS AND DISCUSSION

Drug-Excipients and Drug-Polymer Compatibility Studies

The compatibility of the drugs and polymers employed to create solid dispersions and inclusion complexes was examined using FTIR spectroscopy. The following FTIR spectra, acquired for both pure drugs and drug-polymer combinations, range from 4000 to 400 cm-1.

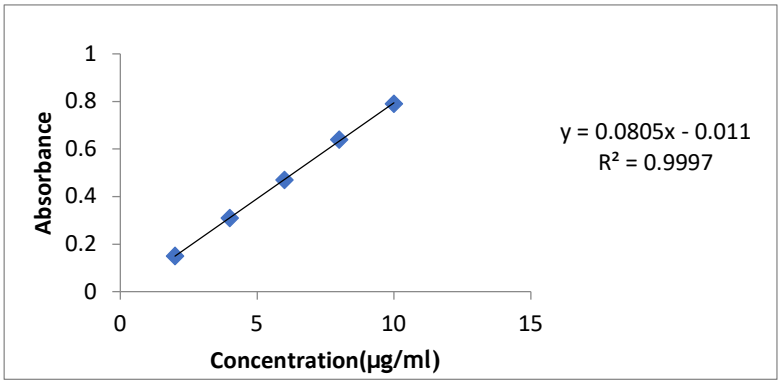

Figure 1: Standard calibration plot of Zaltoprofen in 6.8 Phosphate buffer

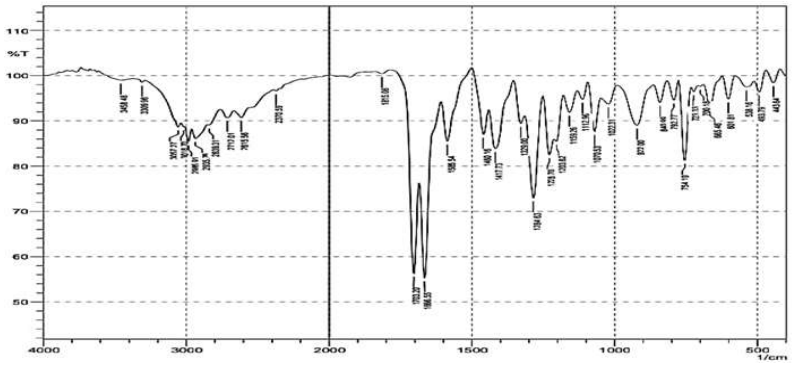

Figure 2: FT-IR Spectra of pure Zaltoprofen drug

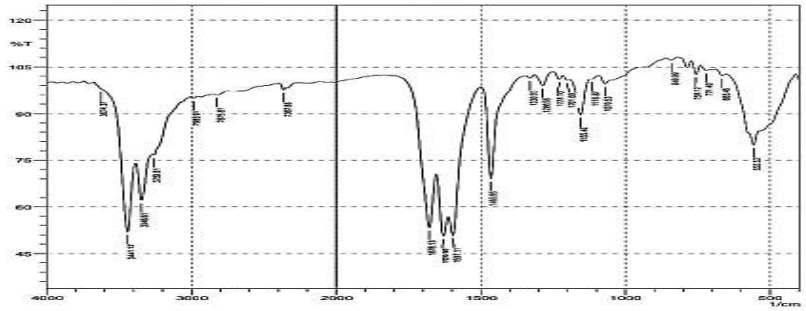

Figure 3: FT-IR Spectra of Zaltoprofen + Urea

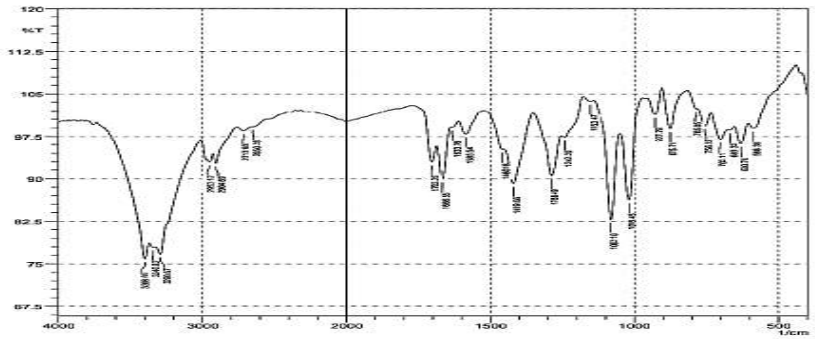

Figure 4: FT-IR Spectra of Zaltoprofen + Mannitol

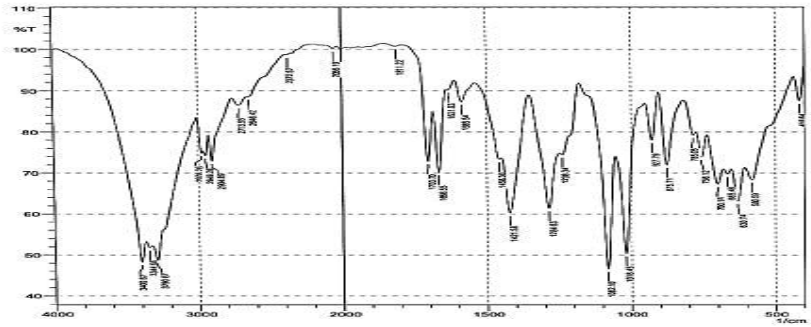

Figure 5: FT-IR Spectra of Zaltoprofen + β Cyclodextrin

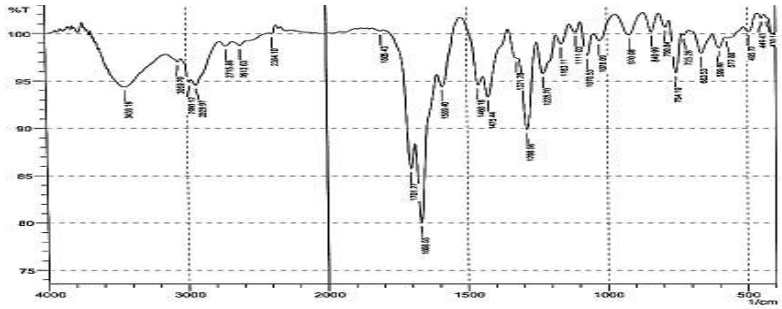

Figure 6: FT-IR Spectra of Zaltoprofen + PEG 6000

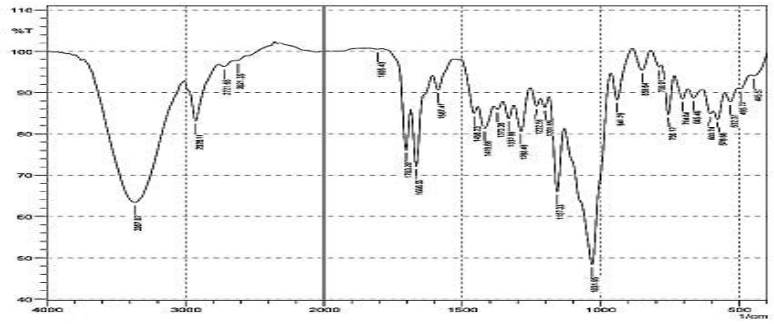

Figure 7: FT-IR Spectra of Zaltoprofen + PVP K 30

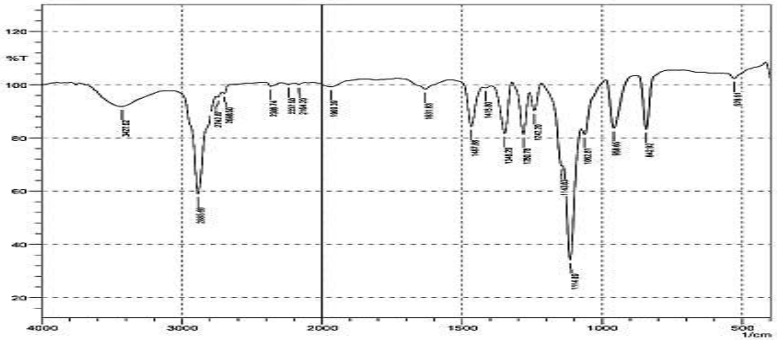

Figure 8: FT-IR Spectra of Zaltoprofen + Polaxamer 188

Table 3: Data for Drug content, solubility study of solid dispersion

Formulation code	Solubility(mg/ml)	Drug content (%)	% Drug release at 120 mins (%)
UP_1	0.17	99.2±0.002	53.34
UP_2	0.22	100±0.2	59.90
UP_3	0.26	99.8±0.05	60.68
MP_4	0.19	97.1±0.8	40.62
MP_5	0.24	97.8±001	42.89
MP_6	0.29	98.5±002	45.77
CP_7	0.21	99.9±005	55.89
CP_8	0.25	100±001	57.22
CP_9	0.32	99.8±006	58.90
PP 11	0.18	99.9±0.002	43.23
PP12	0.22	100±0.2	46.98
PP13	0.35	99.4±0.06	48.12
VP13	0.23	99.2±002	49.81
VP14	0.28	100±02	52.08
VP15	0.34	99.8±005	54.58
LP16	0.51	100±0.9	68.13
LP17	0.57	100±0.8	70.32
LP18	0.62	100±0.05	71.13
UK19	0.53	100±0.002	76.93
UK20	0.61	100±0.2	81.64
UK21	0.69	98.8±0.08	89.43
MK22	0.56	97.2±0.002	78.21
MK23	0.64	97.9±0.2	81.03
MK24	0.67	98.8±0.05	90.65
CK25	0.41	96.2±0.32	79.04
CK26	0.49	96.9±0.2	90.50
CK27	0.53	97.8±0.05	92.36
PK28	0.47	99.9±0.02	79.96
PK29	0.52	100±0.2	82.37
PK30	0.58	98.8± 0.05	90.32
VK31	0.48	98.2±0.2	83.38
VK32	0.54	99.6±0.12	87.27

Formulation code	Solubility(mg/ml)	Drug content (%)	% Drug release at 120 mins (%)
VK33	0.61	100±0.05	91.78
LK34	0.99	99.2±0.9	97.09
LK35	1.09	99.1±0.2	98.23
LK36	1.24	99.8±0.25	99.71
US_{37}	0.31	99.2±0.01	55.28
US_{38}	0.39	98.4±0.9	63.63
US_{39}	0.45	99.8±0.5	69.54
MS_{40}	0.29	99.2±0.12	72.27
MS_{41}	0.32	100±0.2	74.37
MS_{42}	0.36	99.8±0.9	78.14
CS_{43}	0.42	100±0.06	61.17
CS_{44}	0.49	100±0.08	63.89
CS_{45}	0.53	100±0.4	71.23
PS_{46}	0.23	98.9±0.7	72.65
PS_{47}	0.29	100±0.3	79.76
PS_{48}	0.34	98.4±0.09	83.02
VS_{49}	0.41	99.6±0.02	75.61
VS_{50}	0.46	99.8±0.06	81.95
VS_{51}	0.51	99.3±0.2	83.76
LS_{52}	0.68	98.5±0.002	85.89
LS_{53}	0.70	98.6±0.08	89.54
LS_{54}	0.74	99.8±0.5	92.37
UF_{55}	0.19	97±0.42	73.65
UF_{56}	0.24	98.6±0.2	77.21
UF_{57}	0.29	97.8±0.08	83.21
MF_{58}	0.27	98.2±0.09	77.13
MF_{59}	0.31	100±0.54	83.96
MF_{60}	0.35	100±0.21	89.09
CF_{61}	0.29	99.2±0.002	72.31
CF_{62}	0.33	100±0.2	82.84
CF_{63}	0.39	99.8±0.06	89.96
PF_{64}	0.18	99.2±0.002	72.55
PF_{65}	0.23	100±0.2	78.53
PF_{66}	0.28	99.9±0.09	90.46
VF_{67}	0.21	100±0.22	79.72
VF_{68}	0.28	100±0.2	81.48
VF_{69}	0.34	99.7±05	87.22
LF_{70}	0.47	99.9±0.5	77.58
LF_{71}	0.49	100±0.28	86.27
LF_{72}	0.53	100±0.5	91.77

Selection of solid dispersion for preparation of tablets

Tablets of all formulation F1 and F2 are selected on the basis, F1 is prepared by taking pure drug without any carrier or polymer and formulation F2 is selected from above solid dispersion which is having good solubility, drug content, and dissolution rate when compare to all the solid dispersion. Formulation LK_{36} (drug: polaxamer188 in ratio 1:6) shows better result so we consider that as most satisfactory formulation and selected as F2 for further tablet preparation and evaluation.

Table 4: Pre-compression parameters of Tablets

Formulation	F_1	F_2
Bulk Density (g/cc)	0.45±0.014	0.42±0.014
Tapped Density (g/cc)	0.52±0.026	0.47±0.031
Carr's Index	13.46±0.013	10.63±0.012
Hausner's Ratio	1.15±0.015	1.11±0.021
Angle of repose (θ)	30.7°±1.21	26.2°±0.027

Data are expressed as Mean ± SD (n = 3). SD, standard deviation

Table 5: Post-compression evaluation of Tablet

Formulation	F_1	F_2
Thickness (mm)	7.1±0.10	7 ±0.05
Hardness (kg/cm2)	4.5±0.26	5.0±0.28
Weight variation (mg)	595.2±0.20	597±1.25
Friability (%)	0.92±0.003	0.89±0.002
Drug content (%)	97.1%±0.11	98.21±1.7
Disintegration time(min)	1.65±0.30	1.32±0.02

Data are expressed as Mean ± SD (n = 3). SD standard deviation

In vitro drug dissolution

The results of *in vitro* drug release profile different formulations of tablets are given in the following **Table 6**.

Stability studies

The tablets of formulation F_2 were evaluated for different properties after three months of storage in accelerated temperature and pressure. The tablets color and odor remain constant. The following table lists other properties **[19] (Table 7)**.

Table 6: Percentage cumulative drug release of Zaltoprofen from formulated tablets

Sl No	Time (min)	F_1	F_2
1	15	10.20 ±0.11	17.27±0.10
2	30	15. 39±0.14	38.32±0.04
3	45	20.44±0.06	48.73±0.11
4	60	22.86±0.12	62.59±0.12
5	75	30.53±0.02	76.67±0.10
6	90	45.65±0.14	81.84±0.02
7	105	62.86±0.10	92.42±0.12
8	120	72.83±0.02	99.12±0.13

Table 7: Data for Stability study of formulation F2

Parameters	Observation		
	Initials	3month	
		RT	40°C
Nature	Solid Compact	Solid Compact	Solid Compact
Colour	White	White	White
Hardness (kg/cm^2)	5.1±0.02	5.1±0.01	5.1±0.03
Content uniformity (%)	98.21±0.01	98.19±0.02	98.56±0.002
Cumulative % drug release (at the end of 120 min)	99.12±0.13	99.20±0.11	99.14±0.04

DISCUSSION

In this investigation, the solubility of Zaltoprofen was improved to diverse degrees by a solid dispersion made utilizing different hydrophilic carriers. When compared to pure drug, the results of solubility and dissolution trials demonstrated Zaltoprofen's quick and easy solubility and dissolution from all solid dispersions. The formulation of Zaltoprofen with Poloxamer 188 in the ratio of 1:6 (LK36) demonstrated the highest solubility and dissolution out of 72 formulations of Zaltoprofen solid dispersion with various carriers **[20]**.

When compared to pure Zaltoprofen, all solid dispersions exhibited a faster rate of dissolution. Polaxamer was also found to be more effective than other carriers, such as urea, mannitol, PEG 6000, PVP k30, and β-cyclodextrin, because it reduces the the drug's high dispersion and lower energy

needed for dissolving are caused by the interfacial tension that exists between the drug and its solubility medium **[21]**.

Zaltoprofen's solubility in water was determined to be 0.013±0.04 mg/ml by research. Zaltoprofen was manufactured for solid dispersion using several carriers such as urea, mannitol, β-cyclodextrin, PEG 6000, PVP k30, and Polaxamer 188 using physical mixing, kneading, solvent evaporation, and fusion techniques. The kneading method for solid dispersion exhibits greater solubility than alternative approaches, while Polaxamer 188 demonstrates superior solubility in comparison to other carriers **[22-23]**.

Solid dispersion *in vitro* dissolution experiments revealed a percentage of drug release from all formulations that is significantly higher than that of pure drug. Zaltoprofen's rate of dissolution rise as carrier concentration increased. This could be brought on by the drug's improved wettability and a decrease in the tension across the drug-dissolving medium interface. Formulations made using the Kneading method were found to have a higher dissolve rate than formulations made using other methods based on the in-vitro release profile. The formulation with the highest dissolving rate was LK36 (Solid dispersion comprising Zaltoprofen: Polaxamer 188 in 1:6 ratio created by kneading process) in short time than other formulation i.e. 99.71% in 60min **[24]**.

For the preparation of tablets containing 80 mg equivalent of Zaltoprofen, formulation LK36 (a solid dispersion containing Zaltoprofen) was selected as the most suitable option. It is a 1:6 ratio made by kneading Polaxamer 188. Sodium starch was one of the additional excipients utilized in the recipe. Three materials were used: glidant (talc), lubricant (magnesium stearate), and superdisintegrant (glycolate). As a diluent or filler, lactose was used.

The micromeritic properties of prepared solid dispersions showed acceptable Zaltoprofen flow behavior when compared to the micromeritic qualities of pure medication, such as angle of repose, Carr's index, and Hausner's ratio **[25]**.

Each tablet had a round form and was white in color. Thus, tablets had a pleasant appearance and no problems with compression. The tablets' thickness ranges from 7±0.05 to 7.1±0.10 mm, indicating that the compression setting was uniform.

Hardness of tablets ranged from 4.5±0.26to5.0±0.28 kg/cm^2 indicating uniformity in hardness irrespective of weight variation. So, Tablets can withstand abrasion, breaking, capping, and handling during storage, transit, and handling **[26]**.

Disintegration is an important factor for the dissolution of tablet. All tablets showed good disintegration and the disintegration

time ranged from 1.32±0.02 to 1.65±0.30 min. The quick disintegration times (all tablets disintegrated in less than two minutes) meet the pharmacopeial standards for conventional immediate-release tablets, which typically require disintegration within 15 minutes. These results indicate that the tablets are likely to release the active ingredient promptly upon ingestion, which could enhance the onset of therapeutic action **[27]**.

Dissolution of tablets containing solid dispersion of Zaltoprofen was better compared to tablets containing pure Zaltoprofen. Tablet containing pure Zaltoprofen (F1) showed 72.83% drug release in 120 minutes whereas tablet containing solid dispersion (F2) showed 99.12% drug release in 105minutes. Formulation F2 containing solid dispersion of Zaltoprofen: Polaxamer 188 in 1:6 ratio showed the best dissolution among all formulations. The improvement in dissolution is largely attributed to the solid dispersion technique. By dispersing Zaltoprofen within a hydrophilic carrier like Poloxamer 188, the drug's solubility and wettability are increased. Poloxamer 188, a surfactant, reduces the surface tension and enhances the dissolution rate by facilitating better interaction between the drug particles and the dissolution medium **[28-30]**.

CONCLUSION

This study improved the oral bioavailability of Zaltoprofen, a poorly water-soluble NSAID, using solubility enhancement techniques like solid dispersion methods. Carriers such as urea, mannitol, β-cyclodextrin, PEG 6000, PVP K-30, and Polaxamer 188 were employed through kneading, solvent evaporation, fusion, and physical mixing methods. FTIR confirmed Zaltoprofen's compatibility with polymers, with the kneading method showing the best results. The solid dispersion (LK36) with a 1:6 ratio of Zaltoprofen to Polaxamer 188 achieved a 99.71% drug release in 60 minutes. Tablets formulated with LK36 (F2) showed 99.12% drug release in 105 minutes, enhancing solubility and bioavailability.

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REFERENCES

[1] Patel K, Shah S, Patel J. Solid dispersion technology as a formulation strategy for the fabrication of modified release dosage forms: A comprehensive review. Daru J. Pharm. Sci. 2022;30(1):165-89.

[2] Kim JS, Choi YJ, Woo MR, Cheon S, Ji SH, Im D, ud Din F, *et al*. New potential application of hydroxypropyl-β-cyclodextrin in solid self-nanoemulsifying drug delivery system and solid dispersion.

Carbohydr Polym. 2021;271:118433.

[3] Bagwan JA, Adhav DU, Ade DD, Bhalerao DD, Avdhut MS. A review on solid dispersion technique for enhancing solubility of poorly soluble drugs. World J Pharm Res. 2024;87-106.

[4] Kaushik R, Budhwar V, Kaushik D. An overview on recent patents and technologies on solid dispersion. Recent Pat Drug Deliv Formul. 2020;14(1):63-74.

[5] Beenakumari, Harishkumar, Bishnoi. Solid dispersion: its type and mechanism of enhancement of solubility by solid dispersion. J Pharm Res. 2019;8(3):65-71.

[6] Sharma KS, Sahoo J, Agrawal S, Kumari A. Solid dispersions: A technology for improving bioavailability. J Anal Pharm Res. 2019;8(4):127-33.

[7] Dhande LB, Deshmukh MT, Khopade AN, Shete RV, Kunjir VV. A review on solubility enhancement by solid dispersion method. J Drug Deliv Ther. 2021;11(1):182-7.

[8] Prathyusha CH. Compatibility studies of Donepezil with different excipients by using HPLC and FTIR. J Adv Pharm Educ Res. 2013;3(3):273-8.

[9] Vargas LR, Poli AK, Dutra RD, Souza CB, Baldan MR, Gonçalves ES. Formation of composite polyaniline and graphene oxide by physical mixture method. J Aerosp Technol Manag. 2017;9(1):29-38.

[10] Hatem AQ, Ali WK. Preparation and characterization of carvedilol solid dispersion by kneading method. Al Mustansiriyah J Pharm Sci. 2023;23(4):367-77.

[11] Trasi NS, Bhujbal SV, Zemlyanov DY, Zhou QT, Taylor LS. Physical stability and release properties of lumefantrine amorphous solid dispersion granules prepared by a simple solvent evaporation approach. Int J Pharm. 2020;2:100052.

[12] Iqbal A, Hossain S, Shamim A, Islam M, Siddique AT. Formulation, in vitro evaluation and characterization of atorvastatin solid dispersion. Trop J Pharm Res. 2020;19(6):1131-8.

[13] Attia MS, Hasan AA, Ghazy FE, Gomaa E, Attia M. Solid dispersion as a technical solution to boost the dissolution rate and bioavailability of poorly water-soluble drugs. Indian J Pharm Educ Res. 2021;55(13):103-21.

[14] Elmubarak EH, Osman ZA, Abdelrahman MO. Formulation

and evaluation of solid dispersion tablets of furosemide using polyvinyl pyrollidone K-30. Int J Curr Pharm Res. 2021;13(2):43-50.

[15] MS, Hasan AA, Ghazy FE, Gomaa E, Attia M. Solid dispersion as a technical solution to boost the dissolution rate and bioavailability of poorly water-soluble drugs. Indian J Pharm Educ Res. 2021;55(13):103-13.

[16] Ainurofiq A, Fajrin HI, Fitriana A, Andriyani D. Preformulation study of solid dosage form to ensure a stable, efficacious, safe and comfortable product: A review. Int J Pharm Res. 2020;09752366:2-86.

[17] Zhang L, Luan H, Lu W, Wang H. Preformulation studies and enabling formulation selection for an insoluble compound at preclinical stage—from in vitro, in silico to *in vivo*. J Pharm Sci. 2020;109(2):950-8.

[18] Zaborenko N, Shi Z, Corredor CC, Smith-Goettler BM, Zhang L, Hermans A, *et al*. First-principles and empirical approaches to predicting in vitro dissolution for pharmaceutical formulation and process development and for product release testing. AAPS J. 2019;21:1-20.

[19] Gonzalez-Gonzalez O, Ramirez IO, Ramirez BI, O Connell P, Ballesteros MP, Torrado JJ, *et al*. Drug stability: ICH versus accelerated predictive stability studies. Pharmaceutics. 2022;14(11):2324-154.

[20] Li J, Lee IW, Shin GH, Chen X, Park HJ. Curcumin-Eudragit E PO solid dispersion: A simple and potent method to solve the problems of curcumin. Eur J Pharm Biopharm. 2015;94:322-32.

[21] De Mohac LM, Raimi-Abraham B, Caruana R, Gaetano G, Licciardi M. Multicomponent solid dispersion a new generation of solid dispersion produced by spray-drying. J Drug Deliv Sci Technol. 2020;57:750-101.

[22] Zhang M, Zhuang B, Du G, Han G, Jin Y. Curcumin solid dispersion-loaded in situ hydrogels for local treatment of injured vaginal bacterial infection and improvement of vaginal wound healing. J Pharm Pharmacol. 2019;71(7):1044-54.

[23] Tekade AR, Yadav JN. A review on solid dispersion and carriers used therein for solubility enhancement of poorly water-soluble drugs. Adv Pharm Bull. 2020;10(3):359-69.

[24] Postolovic KS, Antonijevic MD, Ljujic B, Radenkovic S, Miletic Kovacevic M, Hiezl Z, *et al*. Curcumin and diclofenac therapeutic efficacy enhancement applying transdermal hydrogel polymer films, based on carrageenan, alginate and poloxamer. Polymers. 2022;14(19):409, 244-69.

[25] Rosa LD, Marques-Marinho FD, Braga SL, Souza JD. Equilibrium solubility study to determine fexofenadine hydrochloride BCS class and challenges in establishing conditions for dissolution profiles applied to suspension. Braz J Pharm Sci. 2020;56.

[26] Zhang M, Zhuang B, Du G, Han G, Jin Y. Curcumin solid dispersion-loaded *in situ* hydrogels for local treatment of injured vaginal bacterial infection and improvement of vaginal wound healing. J Pharm Pharmacol. 2019;71(7):1044-54.

[27] Attia MS, Hasan AA, Ghazy FE, Gomaa E, Attia M. Solid dispersion as a technical solution to boost the dissolution rate and bioavailability of poorly water-soluble drugs. Indian J Pharm Educ Res. 2021;55(13):103-339.

[28] Radke RA, Jain NK. Enhancement of solubility and bioavailability of BCS Class-II ambrisentan: *in vitro*, *in vivo* and *ex vivo* analysis. Int J Appl Pharm. 2022;14(1):67-74.

[29] Tran P, Park JS. Formulation of solid dispersion to improve dissolution and oral bioavailability of poorly soluble dexibuprofen. Pharm Dev Technol. 2021;26(4):422-30.

[30] Alwossabi AM, Elamin ES, Ahmed EM, Abdelrahman M. Solubility enhancement of some poorly soluble drugs by solid dispersion using *Ziziphus spinachristi* gum polymer. Saudi Pharm J. 2022;30(6):711-25.