

Enhancement of Pioglitazone Dissolution by Poloxamer 188-Based Amorphous Solid Dispersion and Development of Immediate-Release Tablets

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ABSTRACT

Objective: The present study aimed to enhance the solubility and dissolution rate of Pioglitazone (PGZ), a poorly water-soluble BCS Class II antidiabetic drug, using Poloxamer 188 (PLX 188) through microwave-induced fusion, followed by development of immediate-release (IR) tablets.

Methods: Binary PGZ:PLX 188 and ternary PGZ:PLX 188:HP β CD solid dispersions were prepared at different ratios using microwave irradiation at 700 W. Corresponding physical mixtures were prepared for comparison. The formulations were evaluated for percentage yield, saturation solubility, and in vitro dissolution using USP Apparatus II in phosphate buffer pH 7.4. The optimized solid dispersion was characterized by FTIR and DSC and subsequently compressed into IR tablets by direct compression. The tablets were evaluated for pharmaceutical quality attributes, drug content, dissolution, and accelerated stability at 40°C/75% RH for 3 months.

Results: Pure PGZ exhibited a saturation solubility of 0.042 ± 0.003 mg/mL. SD-PLX1 (1:1) showed the highest solubility of 52.1 ± 1.8 mg/mL, representing approximately 1240-fold enhancement. It exhibited $98.7 \pm 0.9\%$ drug release within 30 min compared with $22.4 \pm 1.1\%$ for pure PGZ and $85.3 \pm 2.0\%$ for the marketed tablet at 60 min. FTIR indicated no major chemical interaction, while DSC showed thermal transitions at 60.65°C and 198.60°C, indicating the presence of PLX 188 and residual crystalline PGZ, respectively. The optimized tablets showed 18 ± 2 s disintegration time, $99.4 \pm 0.8\%$ drug content, and $99.1 \pm 0.6\%$ drug release at 15 min. After 3 months, assay and dissolution were $98.2 \pm 1.0\%$ and $96.5 \pm 1.3\%$, respectively.

Conclusion: Poloxamer 188-based solid dispersion effectively enhanced PGZ solubility and dissolution and enabled development of rapidly disintegrating IR tablets with satisfactory stability.

Keywords: Pioglitazone, Poloxamer 188, Amorphous Solid Dispersion, Microwave-Induced Fusion, Immediate-Release Tablets, Dissolution Enhancement.

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INTRODUCTION

The enhancement of solubility and dissolution rate of poorly water-soluble drugs remains a major challenge in pharmaceutical formulation development. For orally administered drugs, inadequate aqueous solubility and slow dissolution

can limit the rate and extent of drug absorption and consequently affect their bioavailability. Various formulation approaches, including particle-size reduction, micronization, salt formation, complexation, surfactant-mediated solubilization,

and solid dispersion technology, have been investigated to overcome these limitations [1]. Solid dispersion systems are particularly useful because they can improve drug wetting, dispersion, and dissolution through intimate mixing of the drug with a hydrophilic carrier. The Biopharmaceutical Classification System (BCS) categorizes drugs according to their aqueous solubility and intestinal permeability. BCS Class II drugs are characterized by low aqueous solubility and relatively high permeability, making dissolution a potential limiting factor for their oral absorption [2]. The incorporation of such drugs into hydrophilic solid dispersion systems can enhance their dissolution by improving wetting and drug-carrier dispersion and, depending on the formulation and processing conditions, may alter the physical state of the drug. Pioglitazone (PGZ) is an orally administered antidiabetic drug belonging to the thiazolidinedione class. Its poor aqueous solubility can limit dissolution and presents a formulation challenge for achieving rapid drug release. Therefore, strategies capable of improving its aqueous solubility and dissolution characteristics are of considerable pharmaceutical interest. Poloxamer 188 (PLX 188) is a hydrophilic, non-ionic block copolymer consisting of polyoxyethylene and polyoxypropylene segments. Its hydrophilic character and surface-active properties make it a useful carrier for improving the wetting and dissolution of poorly water-soluble drugs. Hydroxypropyl- β -cyclodextrin (HP β CD) is another hydrophilic pharmaceutical excipient that can enhance the apparent aqueous solubility of suitable drug molecules through inclusion complexation [3]. Microwave-assisted fusion offers a solvent-free approach for preparing solid dispersions. Rapid volumetric heating can facilitate melting and intimate mixing of the drug and carrier, followed by solidification of the resulting system. In the present study, microwave-induced fusion was therefore investigated for the preparation of Pioglitazone solid dispersions using PLX 188, with HP β CD incorporated into selected ternary systems. The optimized formulation was subsequently developed into an immediate-release tablet by direct compression and evaluated for pharmaceutical quality, dissolution performance, and accelerated stability.

MATERIALS AND METHODS

Materials

Pioglitazone was obtained as a gift sample from Cipla Pharmaceutical Ltd., Verna, Goa. Poloxamer 188 and HP β CD were purchased from Glenmark Pharmaceuticals, Sinnar, Nashik. All other chemicals and reagents used were of analytical or pharmaceutical grade. Microcrystalline cellulose (MCC PH 102), croscarmellose sodium, and

magnesium stearate were used for tablet formulation.

Method

Solid dispersions were prepared by the microwave irradiation induced fusion method in three different ratios. Pioglitazone with Poloxamer 188 and HP β CD was weighed according to different weight ratios as shown in Table 1, Table 2, and Table 3. Physical mixtures were prepared as per Table 4 for comparison [4].

Table 1: Formula for the Preparation of Pioglitazone Solid Dispersion with Poloxamer 188 (Binary SDs)

S. No.	Formulation Code	Ratio (w/w) Drug:Polymer
1	SD-PLX1	1:1
2	SD-PLX3	1:3
3	SD-PLX5	1:5

Table 2: Formula for the Preparation of Pioglitazone Solid Dispersion with HP β CD (Binary SDs)

S. No.	Formulation Code	Ratio (w/w) Drug:Polymer
1	SD-HP1	1:1
2	SD-HP3	1:3
3	SD-HP5	1:5

Table 3: Formula for the Preparation of Pioglitazone Solid Dispersion with Poloxamer 188: HP β CD (Ternary SDs)

S. No.	Formulation Code	Ratio (w/w) Drug:Polymers
1	SD-TER1	1:1:1
2	SD-TER3	1:3:1.5
3	SD-TER5	1:5:2.5

Table 4: Formula for the Preparation of Physical Mixtures (PMs)

S. No.	Formulation Code	Ratio (w/w) Drug:Polymer
1	PM-PLX1	1:1
2	PM-PLX3	1:3
3	PM-PLX5	1:5

Microwave Induced Fusion Method

Solid dispersions with different ratios of Pioglitazone with Poloxamer 188 and HP β CD were prepared using the microwave induced fusion

method. Firstly, Pioglitazone with Poloxamer 188 and HP β CD was weighed in ratios of 1:1, 1:3, and 1:5 (w/w) followed by gentle mixing for 5 min using a mortar and pestle. A fixed amount of these mixtures was subjected to microwave irradiation for 5 min, 6 min, and 7 min at a constant chosen power of 700 W in a domestic microwave oven. Only one beaker at a time was placed inside the microwave. The samples were exposed for a predetermined time interval until a homogeneous melt was observed. The beaker was removed and placed at room temperature for solidification. The obtained solid dispersions were pulverized using a mortar and pestle and passed through an 80# sieve. The sized solid dispersions were stored in desiccators until further use. Physical mixtures were prepared by geometric dilution of the drug and polymer in a mortar for 10 min without any heat application [5].

Melting Point Determination of Pioglitazone

The melting point of Pioglitazone was determined using a capillary melting point apparatus.

Solubility Studies

Solubility studies were performed according to the method described by Higuchi and Connors. The saturation solubility of the drug and SDs with Poloxamer 188 and HP β CD respectively (1:1, 1:3, and 1:5 w/w) in distilled water was determined by adding an excess amount of drug and SDs to 50 ml distilled water in conical flasks, which were rotated in an orbital shaking incubator for 72 hr at 37°C $\pm$ 0.5°C. The saturated solutions were filtered through a 0.45 μ m membrane filter, suitably diluted with water, and analyzed by a Jasco V-630 UV spectrophotometer at 269 nm [6].

In Vitro Dissolution Studies

Dissolution studies on Pioglitazone (plain drug), solid dispersions, and tablets were performed using the USP Tablet Dissolution Test Apparatus II (Paddle type). Samples equivalent to 15 mg of Pioglitazone were held in muslin cloth and added to 900 ml of phosphate buffer pH 7.4 maintained at 37 $\pm$ 0.5°C and stirred at 50 rpm. Five ml aliquots were withdrawn at time intervals of 5, 15, 30, 45, and 60 min (for SDs) and 5, 10, 15, 20, 30, 45, 60 min (for tablets) and filtered through Whatman's filter paper (No. 41). An equal volume of fresh dissolution medium was replaced to maintain sink conditions. The filtered samples were analyzed spectrophotometrically at 269 nm. Cumulative percentage of the labeled amount of drug released was calculated [7].

Fourier Transform Infrared Spectroscopy (FTIR)

The KBr discs of Pioglitazone, Poloxamer 188, HP β CD, physical mixtures, and finalized solid dispersions were prepared using an electrically operated KBr Press. A Shimadzu FTIR-5300 Fourier transform spectrophotometer was used to record IR spectra of the prepared discs (4000-400 cm^{-1}) to confirm any interaction of Pioglitazone with other excipients.

Differential Scanning Calorimetry (DSC)

Differential scanning calorimetry studies were carried out to evaluate the ability of the polymer to stabilize the amorphous form of the drug in the SD. A Mettler Toledo DSC 1 was used (nitrogen purge, 50 mL/min). Samples (3-5 mg) were sealed in aluminum pans and heated from 25°C to 250°C at a rate of 10°C/min.

Development of Immediate-Release Tablets

The optimized solid dispersion (SD-PLX1, 1:1 ratio) was selected for tablet development based on solubility, dissolution, and drug loading. Tablets were prepared by direct compression. The formula for the immediate-release tablets (Batch T-SD1) is shown in Table 5. The SD-PLX1 (equivalent to 15 mg PGZ), MCC PH 102, and croscarmellose sodium were blended in a cubic blender for 10 min. Magnesium stearate was added and blended for an additional 2 min. The final blend was compressed on a 10-station rotary tablet press using 8 mm standard concave punches to produce tablets of 200 mg weight and hardness 4-6 kp [8].

Table 5: Formula for Immediate-Release Tablets (Batch T-SD1)

Ingredient	Quantity per Tablet (mg)	% w/w
SD-PLX1 (15 mg PGZ)	30.0	15.0
Microcrystalline Cellulose (PH 102)	158.0	79.0
Croscarmellose Sodium	10.0	5.0
Magnesium Stearate	2.0	1.0
Total Weight	200.0	100.0

Tablet Evaluation

The prepared tablets were evaluated for weight variation (USP <905>), hardness (Monsanto tester), friability (Roche Friabilator, 100 rpm, 4 min), disintegration time (USP <701>, disks, 37°C water),

drug content (UV assay), and *in vitro* dissolution (USP Apparatus II, 900 mL PBS pH 7.4, 50 rpm, 37°C). Accelerated stability studies were conducted per ICH Q1A guidelines (40°C/75% RH) for 3 months, monitoring assay, dissolution, and PXRD.

Statistical Analysis

All experiments were performed in triplicate (n=3). Data are expressed as Mean $\pm$ Standard Deviation (SD). Statistical significance was determined using one-way ANOVA followed by Tukey's post-hoc test ($p < 0.05$) [9].

RESULTS AND DISCUSSION

Melting Point

The melting point of pure Pioglitazone was determined to be $190.5 \pm 0.8^\circ\text{C}$, confirming the purity and crystalline nature of the starting material.

Solubility Studies

Pure Pioglitazone was found to be practically insoluble in water (0.045 ± 0.004 mg/mL), very slightly soluble in methanol and 0.1 N HCl, and practically insoluble in ethanol (95%). The methanolic solution of Pioglitazone showed a maximum absorption (λ_{max}) at 269 nm in the wavelength range of 200-400 nm. Therefore, 269 nm was selected as the analytical wavelength. The standard calibration curve showed good linearity over the concentration range of 2-10 $\mu\text{g/mL}$.

Table 6: Standard Calibration Curve Data of Pioglitazone in Methanol

S. No.	Concentration ($\mu\text{g/mL}$)	Absorbance (λ_{max})
1	2	0.118
2	4	0.209
3	6	0.302
4	8	0.394
5	10	0.487

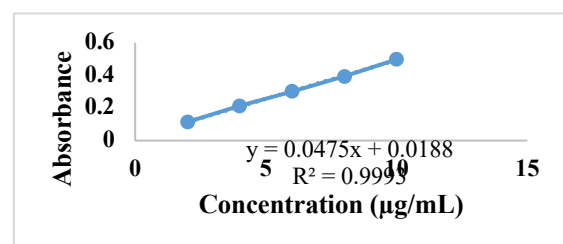


Fig. 1: Calibration Curve of PGZ in Methanol

The results of the phase solubility study are presented in Table 7. The saturation solubility of pure PGZ was 0.042 mg/mL. Among the binary systems, SD-PLX1 (1:1) showed the maximum solubility of 52.1 ± 1.8 mg/mL (1240-fold increase), followed by SD-PLX3 (27.3 mg/mL) and SD-PLX5 (22.6 mg/mL). The ternary systems showed lower enhancement; SD-TER1 (1:1:1) exhibited a solubility of 28.7 ± 1.2 mg/mL (683-fold). HP β CD alone (SD-HP1) increased solubility to 20.2 mg/mL. Physical mixtures (PM-PLX1) showed a solubility of 41.3 ± 1.5 mg/mL (983-fold), which was significantly lower than the corresponding microwave-fused SD ($p < 0.01$), indicating the superiority of the fusion method in generating a high-energy amorphous state.

Table 7: Results of Phase Solubility Study

S. No.	Formulation Code	Drug	Polymers(s)	Ratio (w/w)	Solubility (mg/mL) $\pm$ SD
1	Drug	PGZ	-	-	0.042 ± 0.003
2	SD-PLX1	PGZ	PLX 188	1:1	52.1 ± 1.8
3	SD-PLX3	PGZ	PLX 188	1:3	27.3 ± 1.1
4	SD-PLX5	PGZ	PLX 188	1:5	22.6 ± 0.9
5	SD-HP1	PGZ	HP β CD	1:1	20.2 ± 0.8
6	SD-HP3	PGZ	HP β CD	1:3	17.1 ± 0.7
7	SD-HP5	PGZ	HP β CD	1:5	13.8 ± 0.6
8	SD-TER1	PGZ	PLX 188 + HP β CD	1:1:1	28.7 ± 1.2
9	SD-TER3	PGZ	PLX 188 + HP β CD	1:3:1.5	22.8 ± 0.9
10	PM-PLX1	PGZ	PLX 188	1:1	41.3 ± 1.5
11	PM-PLX3	PGZ	PLX 188	1:3	38.7 ± 1.3
12	PM-PLX5	PGZ	PLX 188	1:5	35.2 ± 1.1

Percentage Yield

The production yield of solid dispersions prepared by the microwave-assisted method ranged from 76.6% to 85.0% (Table 8). The loss in yield was attributed to the product remaining adhered to the walls of the beaker during the melting and cooling

process. The 1:3 ratio (SD-PLX3) gave the highest yield (85.0%), while the optimized 1:1 ratio (SD-PLX1) yielded 82.4%.

Table 8: Results of Percentage Yield

S. No.	Formulation Code	Ratio	Percentage Yield (%)
1	SD-PLX1	1:1	82.4 ± 2.1
2	SD-PLX3	1:3	85.0 ± 1.8
3	SD-PLX5	1:5	76.6 ± 3.2
4	SD-TER1	1:1:1	78.2 ± 2.5

Dissolution Study of Solid Dispersions with Pure Drug

The dissolution profiles of pure PGZ, marketed tablet, and various solid dispersions are shown in Fig. 2 and Table 9. Pure PGZ exhibited poor release (22.4 ± 1.1% at 60 min). The marketed tablet released 85.3 ± 2.0% at 60 min. The optimized binary SD (SD-PLX1) showed rapid and complete release of 98.7 ± 0.9% within 30 minutes. Increasing the polymer ratio (SD-PLX3, SD-PLX5) slightly reduced the dissolution rate at later time points due to increased gel layer viscosity. Ternary systems (SD-TER1) and physical mixtures (PM-PLX1) showed intermediate release profiles (91.8% and ~75% at 60 min, respectively), significantly slower than SD-PLX1 ($p < 0.001$).

Table 9: Dissolution Study of Pure Drug, Marketed Tablet, and PGZ Solid Dispersions (% Drug Release ± SD)

Time (min)	Pure PGZ	Marketed Tablet	SD-PLX1 (1:1)	SD-PLX3 (1:3)	SD-PLX5 (1:5)	SD-TER1 (1:1:1)	PM-PLX1 (1:1)
5	8.2 ± 0.5	28.1 ± 1.2	45.2 ± 1.8	38.5 ± 1.5	32.1 ± 1.3	35.4 ± 1.6	22.5 ± 1.0
15	14.5 ± 0.8	52.8 ± 1.5	82.4 ± 1.2	75.2 ± 1.4	68.3 ± 1.6	70.1 ± 1.5	45.6 ± 1.3
30	18.9 ± 1.0	64.1 ± 1.4	98.7 ± 0.9	96.2 ± 1.3	89.5 ± 1.7	91.8 ± 1.5	62.4 ± 1.4

45	21.1 ± 0.9	78.5 ± 1.6	99.2 ± 0.5	98.5 ± 0.8	95.2 ± 1.2	96.4 ± 1.0	71.2 ± 1.2
60	22.4 ± 1.1	85.3 ± 2.0	99.5 ± 0.4	99.1 ± 0.6	97.8 ± 0.9	98.2 ± 0.8	75.3 ± 1.5

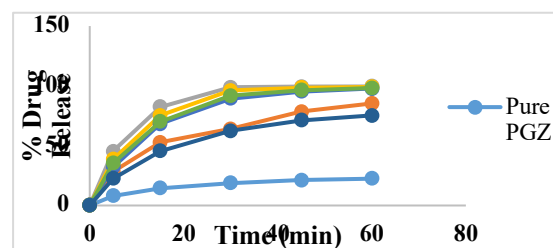


Fig. 2: Dissolution Profiles of Pure Drug, Marketed Tablet, and Solid Dispersions

FT-IR Spectroscopic Studies

FT-IR spectroscopy was performed to investigate the characteristic functional groups of pure Pioglitazone (PGZ) and to assess the possible interactions between PGZ and Poloxamer 188. The FT-IR spectrum of pure PGZ showed characteristic absorption bands at 3314.15 cm^{-1} , attributed to N-H stretching, 3006.01 and 2851.23 cm^{-1} corresponding to C-H stretching vibrations, and a prominent band at 1705.89 cm^{-1} associated with carbonyl (C=O) stretching. Additional characteristic bands were observed at 1590.23, 1459.91, 1310.46, 1261.82, 1210.15, 1111.87, 1010.63, 891.32, 813.23 and 710.63 cm^{-1} , representing various stretching and bending vibrations of the functional groups present in PGZ (Fig. 3). The FT-IR spectrum of the PGZ + Poloxamer 188 physical mixture (PM-PLX1) exhibited characteristic absorption bands at 2898.55, 1682.41, 1462.85, 1341.15, 1214.03, 1103.27, 960.27, 840.26 and 710.13 cm^{-1} (Fig. 4). The prominent absorption band around 1103 cm^{-1} can be associated with the C-O-C stretching vibration characteristic of Poloxamer 188. The characteristic absorption bands of PGZ were retained in the physical mixture, although some variation in peak position and intensity was observed. No prominent new absorption band indicative of the formation of a new covalent functional group was observed. These findings suggest that no major chemical interaction or covalent bond formation occurred between PGZ and Poloxamer 188 in the physical mixture. The changes in the spectral pattern may be attributed to physical mixing and interactions between the drug and carrier.

Enhancement of Pioglitazone Dissolution by Poloxamer 188-Based Amorphous Solid Dispersion and Development of Immediate-Release Tablets

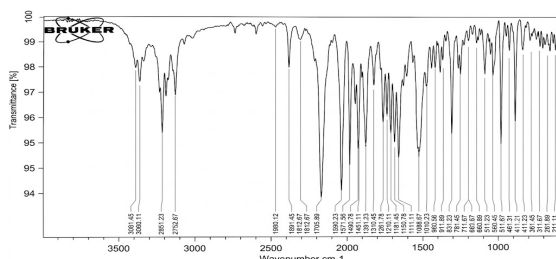


Fig. 3: FT-IR Spectrum of Pure Pioglitazone

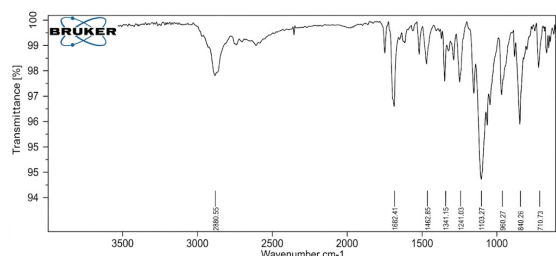


Fig. 4: FT-IR Spectrum of PGZ + Poloxamer 188 (Physical Mixture)

Differential Scanning Calorimetry (DSC)

The DSC thermogram of SD-PLX1 showed two prominent endothermic events at 60.65°C and 198.60°C (Fig 5). The first transition was attributed to the thermal behavior of Poloxamer 188, while the second corresponded to the melting behavior of crystalline PGZ. The results indicate the presence of crystalline PGZ in the formulation, with no complete disappearance of its characteristic melting endotherm.

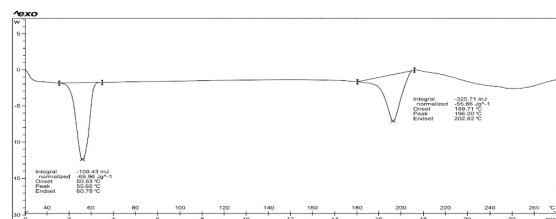


Fig. 5: DSC Thermogram of Optimized Solid Dispersion (SD-PLX1)

Evaluation of Immediate-Release Tablets (Batch T-SD1)

The tablets prepared by direct compression of SD-PLX1 were evaluated for quality attributes (Table 10). All tablets passed weight variation test (200.2 ± 1.1 mg). Hardness was 4.8 ± 0.3 kp, friability was $0.32 \pm 0.05\%$ (well below the 1% limit), and disintegration time was remarkably rapid at 18 ± 2 seconds. Drug content uniformity was $99.4 \pm 0.8\%$.

The tablet T-SD1 achieved $99.1 \pm 0.6\%$ drug release within 15 minutes, significantly faster than the marketed tablet (85.3% at 60 min) and pure PGZ (22.4% at 60 min). The similarity factor (f_2) between the tablet and the loose SD powder (SD-PLX1) was >50 , indicating that the compression process did not alter the dissolution performance or induce crystallization.

Table 10: Post-Compression Evaluation Parameters of Immediate-Release Tablets (Batch T-SD1)

Parameter	Result (Mean $\pm$ SD, n=6)
Average Weight	200.2 ± 1.1 mg
Hardness	4.8 ± 0.3 kp
Friability	$0.32 \pm 0.05\%$
Disintegration Time	18 ± 2 sec
Drug Content	$99.4 \pm 0.8\%$
Dissolution (15 min)	$99.1 \pm 0.6\%$

Accelerated Stability Study

The optimized tablets (T-SD1) were subjected to accelerated stability conditions ($40^\circ\text{C}/75\% \text{ RH}$) for 3 months. The results (Table 11) showed minimal changes in assay (98.2% at 3 months) and dissolution at 15 min (96.5% at 3 months).

Table 11: Accelerated Stability Data for Tablets T-SD1 ($40^\circ\text{C}/75\% \text{ RH}$)

Time Point	Assay (% Label Claim)	Dissolution (% Release at 15 min)
Initial (0 Month)	99.4 ± 0.8	99.1 ± 0.6
1 Month	98.9 ± 0.9	97.8 ± 1.1
3 Months	98.2 ± 1.0	96.5 ± 1.3

DISCUSSION

The present study demonstrated that microwave-induced fusion with Poloxamer 188 can substantially improve the saturation solubility and dissolution performance of Pioglitazone. Among the investigated formulations, SD-PLX1 containing PGZ and PLX 188 at a 1:1 ratio exhibited the highest saturation solubility of 52.1 ± 1.8 mg/mL, compared with 0.042 ± 0.003 mg/mL for pure PGZ, corresponding to approximately 1240-fold enhancement. The higher solubility observed with SD-PLX1 compared with the higher polymer ratios suggests that increasing the PLX 188 concentration did not proportionally improve drug solubilization. The lower solubility observed with SD-PLX3 and SD-PLX5 may be associated with increased viscosity of the hydrated polymeric layer, which can restrict drug diffusion from the formulation. The physical mixture PM-PLX1 showed lower solubility than SD-PLX1, indicating that the microwave-induced fusion process contributed to improved drug-carrier dispersion.

The dissolution study further demonstrated the advantage of SD-PLX1. Pure PGZ exhibited only $22.4 \pm 1.1\%$ drug release at 60 min, whereas the marketed tablet showed $85.3 \pm 2.0\%$ release at 60 min. In comparison, SD-PLX1 exhibited $98.7 \pm 0.9\%$ release within 30 min and $99.5 \pm 0.4\%$ at 60 min. The enhanced dissolution may be attributed to improved wetting and dispersion of PGZ within the hydrophilic PLX 188 matrix. Increasing the PLX 188 concentration slightly reduced the dissolution rate at later time points, which may be related to formation of a more viscous hydrated layer.

FTIR analysis indicated that the characteristic functional groups of PGZ were retained in the physical mixture, with changes in peak position and intensity but without the appearance of a prominent new absorption band. These findings suggest that no major new chemical interaction or covalent bond formation occurred between PGZ and PLX 188.

The DSC thermogram of SD-PLX1 showed two endothermic events at approximately 60.65°C and 198.60°C . The first transition was attributed to the thermal behavior of PLX 188, while the second was associated with the melting of crystalline PGZ. The persistence of the PGZ-associated endothermic event indicates that the drug was not completely converted into an amorphous state during processing. Therefore, the enhanced dissolution of SD-PLX1 should be attributed primarily to improved wetting, dispersion, and carrier-mediated solubilization, with possible partial alteration of the drug's physical state, rather than complete amorphization.

The optimized SD-PLX1 was successfully incorporated into immediate-release tablets by direct compression. The prepared tablets exhibited satisfactory pharmaceutical characteristics, including an average weight of 200.2 ± 1.1 mg,

hardness of 4.8 ± 0.3 kp, friability of $0.32 \pm 0.05\%$, disintegration time of 18 ± 2 s, and drug content of $99.4 \pm 0.8\%$. The tablets achieved $99.1 \pm 0.6\%$ drug release within 15 min, demonstrating rapid dissolution of the optimized formulation.

The accelerated stability study showed only minor changes in assay and dissolution after 3 months at $40^\circ\text{C}/75\%$ RH. The assay decreased from $99.4 \pm 0.8\%$ to $98.2 \pm 1.0\%$, while drug release at 15 min decreased from $99.1 \pm 0.6\%$ to $96.5 \pm 1.3\%$. These results indicate satisfactory maintenance of drug content and dissolution performance during the studied storage period. However, based on the data presented, the absence of recrystallization should not be claimed because corresponding post-stability PXRD data are not provided.

CONCLUSION

The present study demonstrated that microwave-induced fusion using Poloxamer 188 effectively enhanced the saturation solubility and dissolution rate of Pioglitazone. The 1:1 PGZ:PLX 188 solid dispersion (SD-PLX1) exhibited the highest saturation solubility and rapid dissolution compared with pure PGZ and the marketed tablet. FTIR analysis indicated no major chemical interaction between PGZ and PLX 188, while DSC confirmed the presence of PLX 188 and residual crystalline PGZ in the optimized solid dispersion. The optimized SD-PLX1 was successfully formulated into immediate-release tablets by direct compression, showing rapid disintegration, satisfactory drug content, and approximately 99% drug release within 15 min. The tablets maintained satisfactory assay and dissolution performance during 3 months of accelerated stability testing. Overall, the findings demonstrate the potential of Poloxamer 188-based solid dispersion prepared by microwave-induced fusion as a formulation approach for improving the dissolution performance of poorly water-soluble Pioglitazone.

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CONFLICT OF INTERESTS: NIL

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