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Glimepiride Tablet Formulation and Evaluation Using Solid Dispersion for Enhanced Bioavailability

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Abstract - The current study focuses on the formulation and evaluation of Glimepiride 4 mg tablets with the goal of increasing bioavailability and thereby improving therapeutic efficacy in the treatment of type 2 diabetes. Glimepiride, a second-generation sulfonylurea, has low water solubility, resulting in inconsistent and often insufficient oral bioavailability. To address this issue, formulation strategies were used, such as PEG 6000, β-cyclodextrin, superdisintegrants, and solid dispersion techniques. The tablets were compressed directly and assessed for pre- and post-compression parameters such as flow properties, hardness, friability, weight variation, disintegration time, drug content uniformity, and in vitro drug release. When compared to normal tablets, optimized formulations revealed much faster dissolving The in vitro drug release profile revealed a prolonged and enhanced release of Glimepiride, indicating greater solubility and potential for increased bioavailability. Stability investigations conducted in accordance with ICH criteria demonstrated the physical and chemical stability of the improved formulation. The findings indicate that the new Glimepiride 4 mg tablets provide a promising strategy to improving bioavailability and therapeutic effectiveness, potentially allowing for more consistent glycemic control in diabetic patients. Additional in vivo investigations are needed to establish the improved pharmacokinetic profile

Keyword **:** Glimepiride bioavailability enhancement , Glimepiride oral bioavailability, Permeation enhancers. Glimepiride solubility improvement

1.INTRODUCTION

1.1 Background

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia due to insulin resistance, impaired insulin secretion, or a combination of both. It is one of the leading causes of morbidity and mortality worldwide, with type 2 diabetes mellitus (T2DM) being the most prevalent form. According to the International Diabetes Federation (IDF), the global prevalence of diabetes is expected to increase significantly in the coming years, necessitating the development of effective pharmacological interventions.

Among the various classes of antidiabetic drugs, sulfonylureas play a crucial role in the management of T2DM. They act by stimulating pancreatic β-cells to release insulin, thereby lowering blood glucose levels. Glimepiride, a second-generation sulfonylurea, is widely used due to its long duration of action, lower risk of hypoglycemia compared to first-generation sulfonylureas, and improved cardiovascular safety profile. However, despite its therapeutic advantages, Glimepiride has poor aqueous solubility, which poses a significant challenge in achieving optimal bioavailability.

1.2 Problem Statement

Glimepiride is classified under the Biopharmaceutical Classification System (BCS) as a Class II drug, meaning it has low solubility but high permeability. This solubility limitation leads to slow dissolution in gastrointestinal fluids, poor absorption, and variable therapeutic response. Inadequate bioavailability often necessitates higher doses to achieve therapeutic plasma concentrations, which can increase the risk of adverse effects such as hypoglycemia and weight gain.

To overcome these challenges, formulation strategies that enhance the solubility and dissolution rate of Glimepiride are essential. Conventional tablet formulations fail to address these issues effectively, necessitating the development of novel drug delivery approaches.

1.3 Need for Enhanced Bioavailability

The oral bioavailability of a drug is influenced by its solubility, permeability, dissolution rate, and stability in the gastrointestinal tract. Since Glimepiride has high permeability but low solubility, improving its solubility can significantly enhance its bioavailability and therapeutic efficacy.

Several formulation techniques have been explored to improve the solubility and dissolution rate of poorly water-soluble drugs. These include:

- Solid dispersions (drug dispersed in hydrophilic carriers to improve wettability and dissolution)
- Micronization (reducing particle size to increase surface area and dissolution rate)
- Self-emulsifying drug delivery systems (SEDDS) (using lipids to enhance solubilization)
- Inclusion complexes (complexing with cyclodextrins to improve aqueous solubility)

Among these, solid dispersion technology and hydrophilic excipient incorporation have shown promising results in improving the dissolution rate of BCS Class II drugs like Glimepiride.

1.4 Rationale for the Study

Given the increasing prevalence of diabetes and the need for more effective Glimepiride formulations, this study aims to develop and evaluate novel formulations of Glimepiride 4 mg tablets with enhanced bioavailability. By incorporating hydrophilic carriers, solubilizers, and optimized formulation techniques, this research seeks to improve the dissolution and absorption of Glimepiride, leading to faster onset of action, better glycemic control, and improved patient compliance.

1.5 Research Hypothesis

It is hypothesized that formulating Glimepiride using solid dispersion techniques, hydrophilic carriers, and optimized excipient composition will significantly improve its dissolution rate and, consequently, its bioavailability.

1.6 Objectives of the Study

This study is designed with the following objectives:

- To enhance the solubility and dissolution rate of Glimepiride using novel formulation approaches.
- To develop different tablet formulations incorporating solid dispersion techniques and hydrophilic excipients.
- To optimize the formulation based on pre-compression and post-compression evaluations.
- To compare the dissolution profiles of optimized formulations with conventional Glimepiride tablets.
- To conduct stability studies to assess the long-term viability of the optimized formulations.

1.7 Scope of the Study

This study will focus on the formulation, optimization, and evaluation of Glimepiride 4 mg tablets using solid dispersion technology and hydrophilic excipients. It will involve:

- Pre-formulation studies, including drug-excipient compatibility analysis.
- Formulation of different Glimepiride tablet batches using varying concentrations of hydrophilic carriers.
- Pre-compression and post-compression evaluation of formulations.
- Dissolution and stability testing to assess the effectiveness of the optimized formulation.

1.8 Significance of the Study

The significance of this study lies in its potential to improve the therapeutic performance of Glimepiride by enhancing its solubility and dissolution rate. The optimized formulation can lead to:

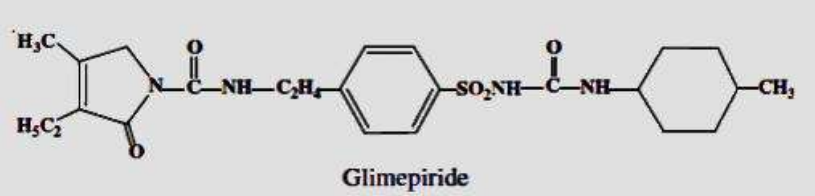
- More consistent blood glucose control in diabetic patients.
- Reduced dosage requirements, minimizing side effects such as hypoglycemia.
- Improved patient compliance due to better efficacy at lower doses.
- Potential for commercial development of more effective Glimepiride formulations.

By overcoming the solubility limitations of Glimepiride, this study contributes to the broader goal of developing improved oral drug delivery systems for poorly soluble drugs.

1.9 Drug Profile

Glimipiride :

Structure :



Glimepiride

Table 1 : Drug Profile

Drug	Glimipiride
IUPAC Name	4-ethyl-3-methyl-N-[2-[4-[(4-methylcyclohexyl)carbamoylsulfamoyl]phenyl]ethyl]-5-oxo-2H-pyrrole-1-carboxamide
Category	Oral hypoglycemic agent , Second-generation sulfonylurea
Molecular Formula	$C_{24}H_{34}N_4O_5S$
Molecular Weight	490.62 g/mol
Melting Point	207°C
pKa	6.2 ± 0.1
Side Effect	Hypoglycemia , Nausea, Dizziness, Weight gain.

2.AIM AND OBJECTIVES

2.1Aim

The aim of the present research is to formulate, optimize, and evaluate Glimepiride 4 mg oral tablets with significantly enhanced bioavailability, in order to overcome the limitations associated with its poor aqueous solubility and variable

gastrointestinal absorption. The ultimate goal is to develop a robust, stable, and pharmaceutically acceptable tablet formulation that exhibits improved dissolution characteristics, enhanced in-vitro drug release, and potential for improved in-vivo absorption, thereby ensuring greater therapeutic efficacy in the management of Type 2 Diabetes Mellitus.

Glimepiride, a third-generation sulfonylurea class antidiabetic drug, is commonly used in the treatment of non-insulin-dependent diabetes mellitus (NIDDM). However, its therapeutic effectiveness is significantly influenced by its Biopharmaceutics Classification System (BCS) Class II nature, characterized by low solubility and high permeability. Due to its poor aqueous solubility, Glimepiride often exhibits delayed and inconsistent onset of action, which may lead to suboptimal blood glucose control, increased risk of side effects, and reduced patient compliance.

Thus, this study is focused on developing an advanced formulation approach that enhances the solubility and dissolution rate of Glimepiride, thereby improving its bioavailability. The formulation will be systematically designed, evaluated, and optimized using suitable pharmaceutical excipients and technological interventions aimed at modifying the drug release profile, improving physicochemical stability, and ensuring patient-friendly dosage form characteristics.

2.2Objectives

To conduct an in-depth preformulation study of Glimepiride to understand its physicochemical and biopharmaceutical properties. This includes solubility analysis in various solvents and pH conditions, determination of melting point, partition coefficient (log P), hygroscopicity, drug-excipient compatibility studies using techniques like FTIR and DSC, and assessment of flow properties for successful tablet formulation.

To investigate and implement suitable strategies for enhancing the solubility and dissolution of Glimepiride, such as the use of hydrophilic carriers, surfactants, solid dispersion techniques, particle size reduction (micronization or nanonization), inclusion complexes (e.g., PEG 6000), and superdisintegrants. The goal is to identify a practical and effective approach that significantly improves drug dissolution.

To formulate multiple trial batches of Glimepiride 4 mg tablets using selected excipients and optimized formulation methods like direct compression, wet granulation, or solid dispersion-based tablet manufacturing. Each batch will be designed to explore different formulation variables affecting drug release and tablet performance.

To perform comprehensive evaluation of the physical and mechanical properties of the formulated tablets, including weight variation, hardness, thickness, friability, disintegration time, wetting time, water absorption ratio, and uniformity of drug content. These parameters are essential to ensure batch-to-batch consistency and compliance with pharmacopeial specifications.

To carry out in-vitro dissolution testing of all formulations, and compare the drug release profiles to identify the formulation that shows the highest drug release within a specified time frame. Dissolution data will be analyzed using kinetic models to understand the release mechanisms and drug diffusion behavior.

To compare the optimized formulation with a marketed Glimepiride product, in terms of dissolution efficiency, similarity factor (f2), and difference factor (f1), to demonstrate the superiority of the newly developed formulation in enhancing drug release and potential bioavailability.

To conduct stability studies on the optimized formulation as per ICH guidelines (accelerated and long-term conditions), evaluating the physical appearance, hardness, drug content, and dissolution profile at predefined intervals. This ensures the developed formulation maintains its quality, safety, and efficacy throughout its shelf life.

To explore the potential mechanism of enhanced bioavailability by analyzing the correlation between improved solubility/dissolution and potential in-vivo absorption, and by reviewing the pharmacokinetic implications of the formulation improvements.

To evaluate the industrial scalability and manufacturability of the optimized Glimepiride tablet formulation, considering aspects such as process reproducibility, cost of production, regulatory compliance, and patient-centered attributes like tablet size, ease of swallowing, and dose accuracy.

3. MATERIALS AND METHODS

3.1 Materials

In order to ensure pharmaceutical-grade quality and uniformity in research results, all of the components utilized in this study to formulate Glimepiride tablets were purchased from reputable Indian suppliers.

The active pharmaceutical ingredient (API) glimepiride was purchased from Yarrow Chem Products, Mumbai, a reputable provider of research-grade APIs utilized in educational establishments.

Merck Life Science (India) supplied the polyethylene glycol 6000 (PEG 6000), which is utilized as a carrier for solid dispersion. Providers provide analytical-grade PEG and excipient, which are well known for their dependability in pharmaceutical research.

BASF India Ltd., Navi Mumbai, provided the polyvinylpyrrolidone K30 (PVP K30), a binder used in the formulation and sold under the trade name Kollidon® K30, which is renowned for its high performance and pharmaceutical quality.

The excipient-grade sodium lauryl sulfate (SLS), which serves as a surfactant to improve medication solubility, was acquired from Loba Chemie and is appropriate for improving dissolving. Finar Ltd., Ahmedabad, which provides USP/NF-compliant excipient grades, was the source of the magnesium stearate used as a lubricant.

DFE Pharma, Hyderabad, a well-known supplier of spray-dried and directly compressible lactose products such as FlowLac®, provided the lactose monohydrate used as a filler and diluent. Furthermore supplied high-purity magnesium stearate, which is necessary for tablet manufacturing and has consistent flow and lubricating qualities.

Used as a glidant, silicon dioxide (colloidal) was purchased from Evonik India Pvt. Ltd. In Mumbai. It is sold under the Aerosil® brand and is renowned for its remarkable flow-enhancing capabilities.

Active Pharmaceutical Ingredient (API):

Glimepiride

Fig 1. Glimipiride API

Table 2 : Ingredients And There Activities

Sr.No	Ingredients	Activitie
1	Glimepiride	API
2	PEG 6000	Solubility Enhance
3	Sodium Lauryl Sulfate	Surfactant

4	PVP K30	Binder
5	Magnesium Stearate	Lubricant
6	Colloidal Silicon Dioxide	Glidant
7	Lactose Monohydrate	Diluent

Table 3: Formulation Table (mg) : Composition of Formulations (F1–F5)

Ingredient	**F 1**	**F 2**	**F 3**	**F 4**	**F 5**
Glimepiride	4	4		4	4
PEG 6000	20	40	60	80	100
PVP K30	40	40	40	40	40
Sodium Lauryl Sulfate	20	20	20	20	20
Magnesium Stearate	10	10	10	10	10
Colloidal Silicon Dioxide	10	10	10	10	10
Lactose Monohydrate	280	260	240	220	200

3.2 Methods

3.2.1 Preparation of Solid Dispersion

To improve Glimepiride's solubility and dissolution by combining it with polyethylene glycol 6000 (PEG 6000) to create a solid dispersion.

A common and efficient way for increasing the solubility of medications that are not very soluble in water is the solvent evaporation method, which was used to create a solid dispersion of glimepiride. This process creates a uniform dispersion of the drug in the carrier matrix by dissolving the drug and carrier(s) in a common solvent and then removing the solvent.

Selection of Carrier -

Two hydrophilic polymers were chosen in order to improve Glimepiride's bioavailability and rate of dissolution:

PEG 6000 is a water-soluble, non-ionic polymer that has good plasticizing and solubilizing qualities.

(PVP K30): A water-soluble polymer that enhances the drug's wettability and dispersion.

Both carriers help to avoid drug crystallization during dissolution, enhance wettability, and increase surface area.

Process -

Weigh glimepiride, PEG 6000, and PVP K30 precisely in accordance with the formulation.To create a transparent, uniform solution, dissolve all ingredients in ethanol while stirring constantly.

Allow the solvent to evaporate at room temperature after transferring the mixture into a petri dish. The solid mass is further dried at 40 to 50°C in a hot air oven until its weight remains constant.

After scraping the dry solid dispersion, grind it with a mortar and pestle and strain it through a #60 mesh screen. The finished solid dispersion should be kept in a desiccator until the tablet is compressed.

The solid dispersion method increases Glimepiride's solubility and rate of dissolution, hence increasing its bioavailability. When Glimepiride is added to a solid dispersion using PEG 6000, the drug's surface area is increased and the particle size is decreased. Because there is a greater surface area exposed to the dissolution media, the solubility is improved and the gastrointestinal system can dissolve the substance more quickly. Additionally, by lowering surface tension and increasing

drug particle wetting, the surfactant (SLS) improves the medication's solubility and rate of dissolution. In conclusion, the solid dispersion method of making Glimepiride tablets entails carefully combining the medication with PEG 6000 and additional excipients, then grinding, disposing of the solvent, and compressing the tablet.Glimepiride's solubility is improved via the solid dispersion method, increasing its bioavailability. Through increased solubility and dissolution rate, this method dramatically raises Glimepiride's bioavailability and improves therapeutic results.

3.2.2Preformulation Studies

Organoleptic Evaluation

Color - White to off-white

Odor - Odorless

Tast - Tasteless/slightly bitter (literature-based)

Appearance - Crystalline powder

Fourier transformed infrared spectroscopy

The Fourier method Samples, specific hydrotropes, and pure medication, such as glimepiride, were all subjected to transformed infrared spectroscopy using an FTIR spectrophotometer.

Angle of Repose

The fixed funnel and freestanding cone processes use a funnel that is fixed with its tip at a certain height, h, and maintained 2.5 cm above graph paper that is placed on a level horizontal surface. The following formula can be used to calculate the angle of repose, where r is the radius of the conical pile's base.

Angle of Repose = $\tan^{-1}$ (h/r)

H is the pile's height, and r is the pile's base radius.

Tapped Density

To increase the bulk density, or tapped density (ρt), a container containing the powder sample is mechanically tapped. The tapped density is determined by mechanically tapping a graduated measuring cylinder 100 times with a given quantity of powder sample. After the initial amount of powder has been established, the least volume (Vt) that the powder takes up in the graduated cylinder is measured. This method is repeated until there is little to no additionally volume change.

Formula for Tapped Density = Mass of an untapped Powder sample /Final Tapped volume

Bulk Density

Including the contribution of the interparticulate void volume, the bulk density of mix powder is calculated by dividing the mass of an untapped powder sample by its volume.

Formula for Bulk Density = Mass of untapped Powder / Untapped Volume

Carr's Index

The Carr index frequently serves in pharmaceutics to determine a powder's compressibility.

Formula For the Carr's Indix = Tapped Density – (Bulk Density / Tapped Density) × 100

Hausner ratio By dividing a powder's tapped density by its bulk density, one can determine the Hausner ratio, which is a gauge of the powder's flowability. While a greater Hausner ratio denotes poor flowability, one near 1 indicates acceptable flowability.

Formula for Hausner Ratio = Tapped Density / Bulk Density

3.3.3 Evaluation of Tablet (Post Formulation Studies)

Drug Content Determination

Ten tablets from each formulation batch were weighed and ground into powder. A 100 mL volumetric flask was filled with powder that had been carefully weighed to equal 4 mg of glimepiride. In order to guarantee full drug extraction, methanol was added and sonicated for fifteen minutes. Phosphate buffer (pH6.8) was used to dilute the solution after filtering. A UV-Visible spectrophotometer was used to test the solution's absorbance at 228 nm.

Formula:

Drug Content= Absorbance of Sample /Absorbance of Standard × Label Claim(mg)

Drug Content % = Drug Content / Label Claim (mg) × 100

Weight variation

For each formulation, the average weight of the randomly selected tablets was determined. After that, the weight of each tablet was calculated and compared to the average.

Formula :

Weight Variation = Some of Table Weight/ Number of Tablet

Friability

A friability tester places the tablets in a spinning drum to measure the weight loss that results from the tablets fracturing or chipping under pressure, vibration, or friction.

Formula for Friability : = $(W_{(initial)} - W_{(final)} / W_{(final)}) \times 100$

Hardness

The tablets' hardness is determined by how much force is required to crush them. Kg/cm2 is the unit of measurement.

In Vitro Disintegration test

Disintegrating apparatus was used to measure the produced tablets' in-vitro disintegration test results. To perform the disintegration test, one tablet was put into each tube of the basket. The bottom of the basket is composed of a stainless steel screen with mesh size 10. It was submerged in a 37 ± 0.5ºC water bath. A stop watch was used to measure how long it took for the tablet in each tube to completely dissolve. With increasing PEG 6000 concentrations, the disintegration time of Glimepiride tablets gradually lowered, indicating PEG 6000's efficacy as a disintegrant-enhancer. Formulation F5 had the quickest disintegration time (2:55 minutes), which can improve medication solubility and possibly increase bioavailability.

In-Vitro Dissolution Study

The produced Glimepiride solid dispersions were subjected to an in vitro dissolving study using the USP dissolving Apparatus II (paddle method) at 50 rpm in 900 mL of 0.1 N HCl (pH 1.2) or phosphate buffer pH 6.8 that was kept at 37 ± 0.5°C. The dissolution media was filled with solid dispersion samples that contained 4 mg of glimepiride. 5 mL

samples were taken out and replaced with an equivalent volume of fresh medium at predetermined intervals (5, 10, 15, 30, 45, and 60 minutes) in order to preserve sink conditions. The amount of medication released was measured by spectrophotometric analysis at 228 nm after the extracted samples were passed through a 0.45 µm membrane filter. A time plot was created using the cumulative proportion of medication dissolved. The solid dispersion formulations' better wettability, decreased crystallinity, increased surface area, and the solubilizing effects of PEG 6000, PVP K30, and SLS were all responsible for the much higher dissolving rate as compared to pure Glimepiride. The potential for increased oral bioavailability of Glimepiride using the solid dispersion approach is indicated by this improved dissolving behavior.

4. RESULTS AND DISCUSSION

Glimepiride solid dispersions and excipients were evaluated pre-formulation to determine powder flow characteristics, which are essential for consistent die filling and controlling tablet weight fluctuation during compression.

Determination of wavelength of maximum

Absorbance (λmax value)

The wavelength of maximum absorbance (λmax) was determined by preparing a standard glimepiride solution with methanol as the solvent. On a UV-Visible spectrophotometer, the solution was scanned in the UV range of 200–400 nm. The λmax, or wavelength at which the absorbance was highest, was noted. At 228 nm, glimepiride's absorbance peaked.

Fourier transformed infrared spectroscopy

In order to prove that there is no chemical interaction between the drug and polymers, the FTIR spectral analysis showed that neither the appearance nor the disappearance of any characteristics peaks of the pure drug glimepiride occurred in the physical mixture.

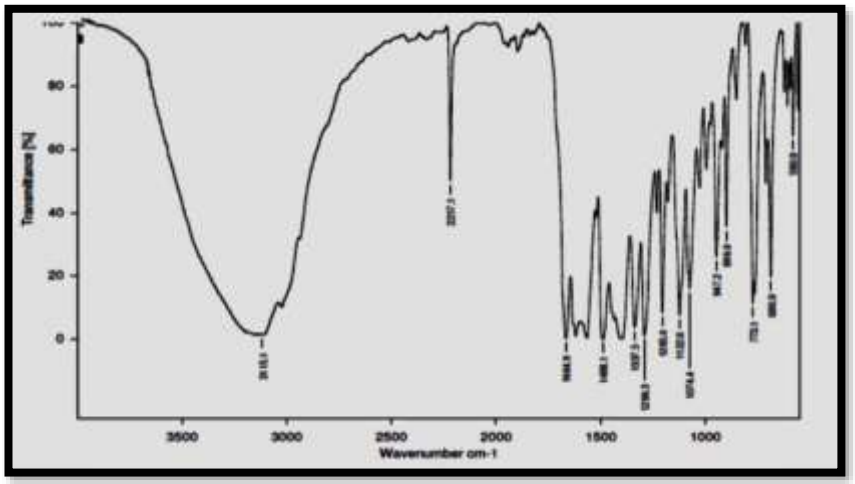


Fig 2. FTIR for study of drug glimepiride. (Pure Drug)

Table 4 : FT-IR study of drug glimepiride. (Pure Drug)

Functional Group	Observed Frequency
C = H	1488.1,1337.5
N= H	3115.1
S= O	1074.4

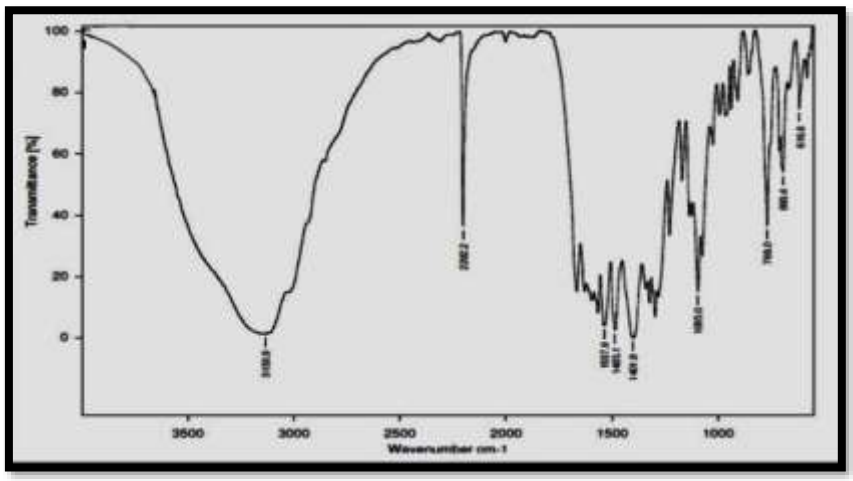


Fig 3. FTIR for study of drug glimepiride. (Physical Mixture)

Table 5: FT-IR study of drug glimepiride. (Physical Mixture)

Functional Group	Observed Frequency
C = H	1485.1
N = H	3133.9
S = O	1401.9
C = O	1537

Angle of Repose

The angle of repose values for all formulations (F1–F5) ranged from 45° to 23.65° , suggesting excellent to good flow characteristics. The flow increased with increasing PEG 6000 concentration, likely due to its lubricating nature and reduced interparticle friction.

Table 6 : Angle of Repose

Formulation	Angle of Repose
F1	45.00°
F2	34.77°
F3	29.60°
F4	25.64°
F5	23.65°

Tapped Density

In order to demonstrate the powder's capacity to pack under mechanical tapping, the taped density values rose from 0.667 to 0.617. Tighter particle arrangement during tapping was made possible by the powders' tendency to become more cohesive as the PVP K30 level rose.

Table 7 : Tapped Density

Formulation	Tapped Density
F1	0.667
F2	0.658
F3	0.647
F4	0.621
F5	0.617

Bulk Density

The bulk density varied between 0.612 to 0.579. The poor packing behavior of tiny, sticky particles may have contributed to the lower bulk densities that were seen as the PVP K30 concentration increased. Formulation F1 exhibited the largest bulk density, suggesting that the powder particles settled more readily, leading to improved compressibility.

Table 8 : Bulk Density

Formulation	Bulk Density
F1	0.612
F2	0.605
F3	0.597
F4	0.582
F5	0.579

Carr's Compressibility Index

An essential metric for determining the compressibility of powder blends, Carr's Index, was used to analyze the flow characteristics of the generated Glimepiride solid dispersion formulations (F1–F5). In tablet manufacture, uniform die filling, constant tablet weight, and eventually medication release and bioavailability are all dependent on good flow characteristics.

From F1 to F5, there was a downward trend in Carr's Index as the PEG 6000 concentration rose from 20 mg to 100 mg. As a result of its lubricating and plasticizing qualities, which lower interparticle friction, larger concentrations of PEG 6000 may improve the blend's flowability. When dies are filled more uniformly during tablet compression, improved flowability helps to improve tablet uniformity and consistency in medication content. In order to achieve optimal bioavailability, this homogeneity is critical for guaranteeing both consistent drug release and dose accuracy. Furthermore, the poorly water-soluble Glimepiride may become more soluble with the use of the solid dispersion method employing PEG 6000, increasing its bioavailability.

Formulation F5 had the best flow property out of all the batches, with the lowest Carr's Index (6.15%). This formulation has the highest PEG 6000 content (100 mg), which offers the possibility of greater medication absorption and dissolution in addition to improved manufacturability.

Table 9 : Carr's Compressibility Index

Formulation	Carr's Index
F1	8.24
F2	8.05
F3	7.72
F4	6.25
F5	6.15

Hausner ratio

The generated Glimepiride solid dispersion formulations (F1–F5) were evaluated for flow characteristics using the Hausner Ratio and Carr's Index, two crucial metrics for determining the compressibility and flowability of powder blends. Indirectly influencing bioavailability, these characteristics have a direct impact on the consistency of tablet weight and drug content.

For every formulation, the Hausner Ratio values are within the excellent flow range (1.00–1.11), which validates the high-quality compressibility of the powder blends and supports the Carr's Index results. With rising PEG 6000 concentrations, better flow characteristics are shown by a steady decline in both the Hausner Ratio and Carr's Index from F1 to F5. As a plasticizer and flow enhancer, PEG 6000 probably lowers interparticle friction and promotes more consistent die filling when tablets are compressed.

Bioavailability Implications

Improved flow characteristics support uniform tablet weights and drug content, both of which are essential for dependable and predictable drug release patterns. The consistency guarantees that every pill contains the appropriate amount of Glimepiride, which is particularly important for a medication used to treat diabetes when exact dosage is necessary. Furthermore, Glimepiride's solubility and dissolution are improved by the addition of PEG 6000 as a carrier in the solid dispersion, which is crucial for raising the drug's bioavailability as a weakly water-soluble medication. With the lowest Hausner Ratio (1.065) and Carr's Index (6.15%) among the evaluated formulations, F5 demonstrated superior flowability, which enhances manufacturing performance and may lead to maximal bioavailability.

Table 10 : Hausner ratio

Formulation	**Hausner ratio**
F1	1.089
F2	1.087
F3	1.083
F4	1.067
F5	1.065

Table 11 : Evaluation test of Tablet (Post Formulation Studies)

Formulations F1 through F5 remained within acceptable ranges for all post-formulation evaluation criteria. Increasing the concentration of PEG 6000 enhanced medication solubility and tablet disintegration without sacrificing mechanical strength.

Formulation	**Drug Content**	**Weight Variation**	**Friability**	**Hardness (kg/cm^2)**	**Disintegration Test(min)**
F1	98.7%	384.5	1.54%	3.40	5.25
F2	99.1%	384.3	0.51%	3.68	4.40
f3	100.2%	384.5	2.05%	4.02	4.10
F4	99.6%	384.3	1.03%	4.4	3.35
F5	101.0%	384.6	2.56%	4.8	2.55

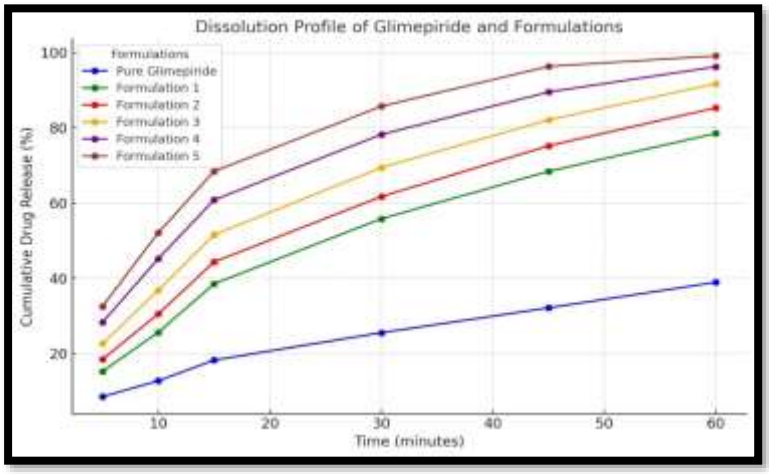
Table 12 : In vitro dissolution study of solid dispersion

(Drug release in 0.1 N HCl with 0.5% SLS, 100 rpm, 37 ± 0.5°C)

Time (min)	**Pure Glimipiride (%)**	**Formulation 1(%)**	**Formulation 2%**	**Formulation 3(%)**	**Formulation 4(%)**	**Formulation 5(%)**
5	8.5	15.2	18.4	22.6	**28.3**	32.5
10	12.7	25.6	30.5	36.8	45.2	52.1
15	18.2	38.5	44.3	51.5	60.8	68.4

35	25.5	55.8	61.7	69.4	78.2	85.7
40	32.1	68.4	75.2	82.1	89.5	96.3
60	38.9	78.5	85.3	91.7	96.2	99.1

Fig 4. In vitro Dissolution Data for Pure Drug and Different Batches



5.CONCLUSION

The current study aimed to increase the bioavailability of glimepiride, a Class II medication classified by the Biopharmaceutics Classification System (BCS) due to its high permeability and poor water solubility. Glimepiride has a low solubility, which restricts its rate of dissolution and, in turn, its oral bioavailability. In order to improve solubility and dissolving properties, solid dispersion techniques were used with PEG 6000 acting as a hydrophilic carrier. Glimepiride was added to PEG 6000 in five distinct formulations (F1–F5) at progressively higher dosages (20 mg–100 mg). Along with lactose monohydrate as a filler, the formulations also included sodium lauryl sulfate as a surfactant to increase wetting, and PVP K30 as a binder and solubility enhancer.

As lubricants and glidants, respectively, magnesium stearate and colloidal silicon dioxide were added. To facilitate direct comparison, each formulation kept the overall tablet weight constant at 384 mg. Pre-compression and post-compression parameters, such as flow characteristics, hardness, friability, drug content, and in-vitro dissolution investigations, were assessed for the generated solid dispersions. The formulation with the highest concentration of PEG 6000 (100 mg), F5, showed the greatest improvement in drug dissolution out of all of them. Glimepiride's decreased crystallinity, enhanced wettability, and the larger surface area of the drug particles distributed throughout the hydrophilic carrier matrix are all responsible for this improvement. The drug's transition to an amorphous or less crystalline state would be further supported by solid-state characterisation methods like FTIR (if used).

The dissolution rate Improved in direct proportion to the PEG 6000 concentration, indicating a robust relationship between the polymer content and improved bioavailability. Glimepiride's dispersion and solubilization were further aided by PVP K30 and sodium lauryl sulfate, which improved micelle formation and polymer wetting, respectively. The formulation's physical stability and compatibility were validated by the consistent tablet properties and the lack of any notable drug-excipient incompatibility.

The study effectively showed that PEG 6000 Is a practical and effective way to increase Glimepiride's solubility and rate of dissolution in solid dispersion formulations, which may subsequently increase its bioavailability when taken orally. A reference for upcoming scale-up and in-vivo bioavailability investigations, Formulation F5's better dissolving profile made it the most promising contender. In order to improve the bioavailability of additional medications that are not very water soluble, our study recommends the wider use of solid dispersion techniques employing PEG 6000 and related

hydrophilic polymers. Future research could concentrate on in-vivo pharmacokinetic investigations, stability testing in accordance with ICH recommendations, and scale-up process optimization to validate the in-vitro results and demonstrate the improved therapeutic efficacy of the modified formulation.

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BIOGRAPHIES

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