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Research Article

UV SPECTROPHOTOMETRIC METHOD DEVELOPMENT AND QUANTITATIVE ESTIMATION OF GLIPIZIDE IN BULK AND PHARMACEUTICAL DOSAGE FORMS

Bikash Ranjan Jena[1], **Suryakanta Swain[1*]**, Sitty Manohar Babu[1], Debi Prasad Pradhan[2] and Kothamasu Sasikanth[1]

[1]Southern Institute of Medical Sciences, College of Pharmacy, Mangaldas Nagar, Vijyawada Road, Guntur-522 001, Andhra Pradesh

[2]GITAM Institute of Pharmacy, GITAM University, Gandhinagar Campus, Rushikonda, Visakhapatnam-530045, Andhra Pradesh, India

ABSTRACT

The present study demonstrates a simple, precise and accurate UV spectrophotometric method development for the quantitative estimation of glipizide in bulk and pharmaceutical dosage forms. The analysis was carried out by using Elico SL 159 UV –Visible spectrophotometer with 1cm matched quartz cells. In this study, the zero order spectrum of glipizide in the presence of phosphate buffer (pH 3.8) is conducted and measured the absorbance at λ_{max} 230 nm. The method was verified by using various validation parameters such as linearity, accuracy, precision. The calibration curve was linear over the concentration range tested (1–50 µg/mL). The accuracy and precision studies were carried out which is less than 2% that indicates good accuracy and precision values. There is no interference of excipients used in the formulation as low % RSD values in the recovery studies. These results indicate that the method shows a practical application as a quality control tool for analysis of the drug in its tablet dosage forms in pharmaceutical industries. The developed method was validated according to ICH-Q1C guidelines and it is applicable for the analysis of bulk drug in its tablet dosage forms.

Keywords: Glipizide, Optical characteristics, Percentage of recovery, Precision, Accuracy.

INTRODUCTION

Glipizide is denoted as an oral hypoglycemic agent which is totally low dose active and having a characteristic feature of sulfonylureas of the second generation. It is well known

as most commonly prescribed drugs for treatment of type II diabetes. Therefore it is denoted as an oral hypoglycemic drug from sulfonylurea group and it is also an effective agent which undergoes second generation oral therapy with glipizide comprises problems of bioavailability fluctuations. Sometimes the drug is also associated with various gastric disturbances and various conditions such as hypoglycemia. However, it is also closely associated with other sulfonylureas of having similar therapeutic class such as glibenclamide, blood insulin, courses differ but it also carries much lower risk of hypoglycemic effect. Hence it is an oral medium-to-long acting anti-diabetic drug from the sulfonylurea class (Shammi *et al.*, 2010 and Norris E. *et al.*, 1979). Since the drug glipizide is broadly classified as a class II sulfonylurea of biopharmaceutical classification system. (BCS), which indicates that it undergoes enterohepatic circulation as well as poor water solubility (Jamzad *et al.*, and Jamzad S *et al.*, 2006). Glipizide shows to lower down the blood glucose acutely by encouraging the insulin and its secretion from pancreas (J. Lin, *et al.*, 2004). Extrapancreatic effects also may play an important part in the mechanism of action of oral sulfonylurea hypoglycemic drugs. The mechanism by which glipizide lowers down blood glucose during long-term administration has not been properly identified and established. In case of human beings the stimulation of insulin secretion by glipizide within response to a meal is of major importance (https://www.accessdata.fda.gov; https://pubchem.ncbi.nlm.nih.gov).

As it is the second generation sulfonylurea that is extremely useful for the medication of noninsulin-dependent diabetes mellitus (Lebovitz H.E, *et al.* , 1983 and Ambrogi V, *et al.* , 1972). This drug has proven to be the most potent as that of the other derivatives of sulfonylurea. (Shuman C.R, *et al.* 1983). It acts by blocking potassium channels in the beta cells of islet of langerhans (Kavalali G, *et al.* 2003). The chemical classification of glipizide is Sulfonylurea compounds. It is chemically regarded as N-(4-[N-(cyclohexyl-carbamoyl)sulfamoyl]-phenethyl)5-methylpyrazine-2-carboxamide (Fig.1). Glipizide is an oral diabetes medicine that helps to control blood sugar levels by helping your pancreas produce insulin. Glipizide is used together with diet and exercise to deal with type II diabetes. It is an oral hypoglycemic agent which is rapidly absorbed and completely metabolized (Merck Index 2001 and S. R. Lahoti *et al.*, 2010). It also becomes short-acting, second generation sulfonylurea with hypoglycemic activity. Glipizide is rapidly absorbed, has a very quick onset of action and a short half-life. This agent is extensively metabolized in the liver and the metabolites as well as the unchanged form is excreted in the urine. Mechanism of action is produced by blocking potassium channels in the beta cells of the islets of langerhans. By partially blocking the potassium channels, it will increase the time the cell spends in the calcium release stage of cell signaling resulting in an increase in calcium. Depolarization stimulates calcium ion influx through voltage-sensitive calcium channels, increasing the calcium ions, intracellular concentrations which ultimately lead to the secretion, or exocytosis, of insulin. The increase in calcium will initiate more insulin release from each beta cell. (https://www.drugbank.ca/drugs). In addition to this advantages its having some other special merits, such that it has been shown (i) to stimulate action of insulin

by means of extrapancreatic effects; (ii) to enhance and control of blood glucose; and (iii) lowering the level of glucose plasma and to maintain this effect even if having short half-life and (iv) to influence the prime pathophysiologic abnormalities, and target-cell resistance to insulin observed in noninsulin-dependent diabetes (C. R. Shuman *et al.*, 1983). The present study based on calculation of absorbance of zero order spectrum of glipizide in phosphate Buffer (pH 3.8) Here the absorbance was measured at λ_{max} 230 nm. From the various literature findings it was found that several methods have been published for the determination of glipizide in either in pharmaceutical preparations and biological fluids but in the present work, an attempt has been made in order to quantify the present drug by spectrophotometric methods, which is very simple, convenient and cost effective rather than other sophisticated analytical techniques such as HPTLC (Darshana K, *et al.* 2012) and HPLC (Yu H Nola, *et al.* 2008, S Dhawan *et al.* 2003, Shaikh Rahila *et al.* 2010, B. Udaykumar Rao, *et al.* 2010) etc.

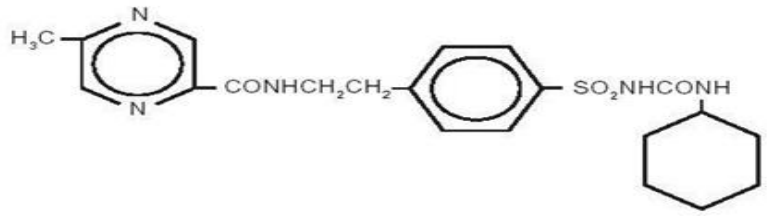

Figure 1: Chemical structure of glipizide.

EXPERIMENTAL

Materials and reagents

Glipizide was obtained as a gift sample from Ranbaxy laboratories ltd, Gurgaon, Haryana, India. All the reagents used in these techniques were of analytical grade. First of all phosphate buffer (pH 3.8) was prepared according to a standard method of preparation and specifications, since the Pka value of glipizide is 5.9. Anhydrous disodium hydrogen phosphate, citric acid monohydrate are used as major chemicals. For pH adjustment ortho phosphoric acid (OPA), NAOH, is used. Methanol and distilled water is used as solvent. In addition, an electronic balance (Meter Toledo), a pH meter (Metter Toledo), a sonicator (Power sonic), a hot air oven (Serve well), centrifuge (REMI), vacuum oven (Centex), and shaking water bath (JEIO Tech) were used in this study.

Instrumentation and spectroscopic condition

The analysis was performed by using Elico SL 159 UV-Visible spectrophotometer with 1 cm matched quartz cells. Here zero order spectrum of the drug is found out by calculating the absorbance at λ_{max} that is 230 nm in phosphate buffer 3.8.

Preparation of phosphate buffer (pH 3.8)

Phosphate Buffer (pH 3.8) was prepared by dissolving 0.09gm of anhydrous disodium hydrogen phosphate and 1.3 gm of Citric acid monohydrate in sufficient distilled water to produce 1000 ml. After that pH with was adjusted by using phosphoric acid or NAOH to get the pH up to 3.8. The UV spectrum of glipizide in phosphate buffer (pH 3.8) is shown in figure 2.

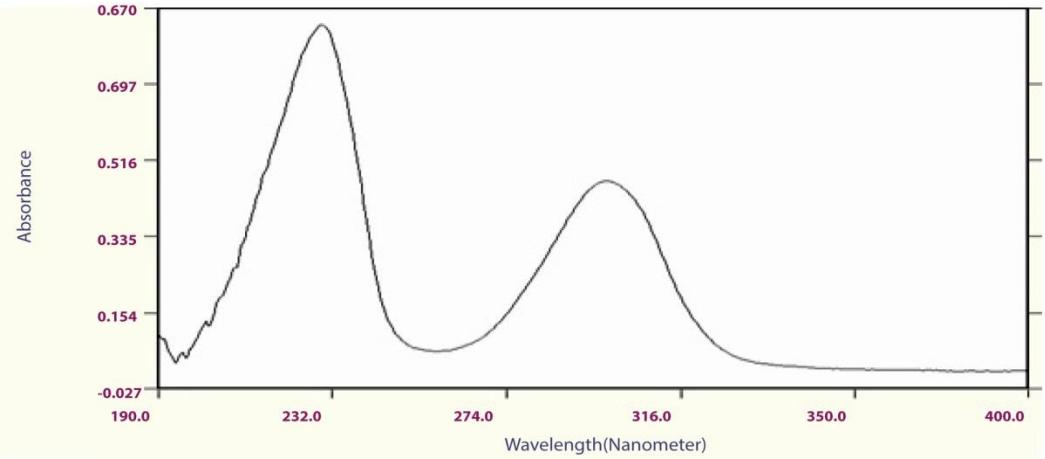

Figure 2: UV Absorption Spectrum of glipizide in phosphate buffer (pH 3.8) (20µg/ml)

Preparation of standard stock solution

Accurately weigh 25 mg of glipizide and it was dissolved in methanol. The volume was make up to 25 ml (1000 µg/ml). Further a working standard solution was prepared by diluting 5 ml of the stock solution to 50 ml with phosphate Buffer (pH 3.8), which contains 100 µg/ml of glipizide.

Calibration curve

Aliquots of the working standard solution of glipizide (0.02 - 6 ml) were transferred into 10 ml volumetric flasks and the volume was made up to the mark with phosphate buffer (pH 3.8). The corresponding absorbance of zero order spectrum of these solutions were measured at the λ_{max} 230 nm against reagent blank. The calibration curve of glipizide is shown in figure 3.

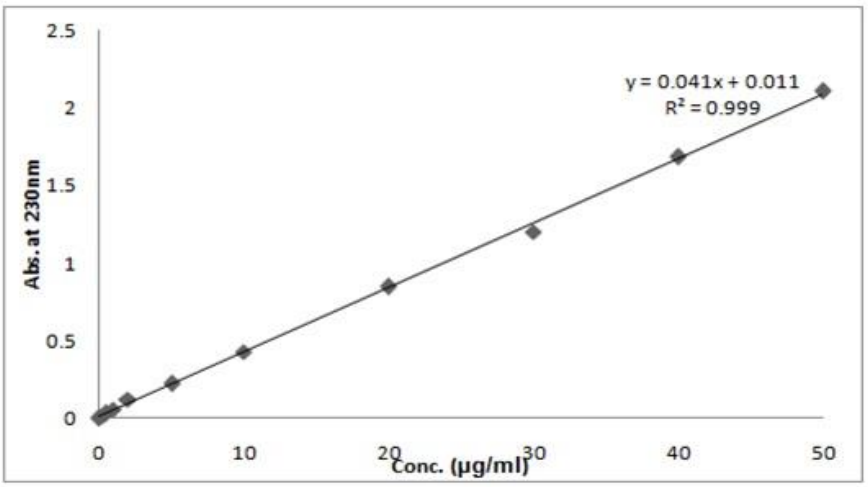

Figure 3: Calibration curve of glipizide in phosphate buffer (pH 3.8)

Assay of formulation

Twenty tablets were accurately weighed, finely powered and powder equivalent to 25 mg of glipizide was taken in a 25 ml volumetric flask and extracted with methanol. The resultant solution was sonicated, filtered and analysed properly and subjected for analysis. The results of assay of formulations are shown in table 1.

Table 1: Results of assay of formulation of glipizide.

Brand Name	Labelled amount (mg)	Amount found (mg)	% Assay
1	Zycel 200 (Zydus Healthcare ltd)	199.74	99.87
2	D Glip 5 (Grandix Pharmaceutical)	5.01	100.2

Method validation

Method validation is carried out in order to confirm that the analytical procedure is employed for a particular experiment is suitable for its intended use. The outcomes of method validation parameters can be highly required to judge the reliability, quality and consistency of analytical results. The validity of the method for accuracy, precision, linearity are carried out according to recommendations of ICH guidelines (ICH Guidelines Q2 (R1), 2005, ICH Guidance for Industry In; Q2A 1994, ICH Guidance for Industry In; Q2B, 1996).

Accuracy

The recovery study of glipizide was carried out at different spike levels (80, 100 and 120%). The percentage recovery was calculated and it was found within the range of 98 to 102%. The % RSD are also found within 2%. The results are obtained as showed in table 2.

Precision

Precision is carried out to the degree of agreement among individual results. The total procedure shall be applied repeatedly in order to separate identical samples obtained from the similar homogeneous batch of material. The developed method was validated by precision (both intraday and interday) and the results of intraday and interday precision of six replicate injections are discussed in table 3 and 4 respectively.

Table 2: Accuracy data of glipizide.

No. of preparations Spike level	**Amount of drug added**	**Amount of drug found**	**% Recovery**
S_1: 80 %	20	19.96	98.08
S_2: 80 %	20	19.94	99.04
S_3: 80 %	20	19.97	99.95
S_4 : 100 %	25	24.98	99
S_5: 100 %	25	24.84	99.86
S_6: 100 %	25	24.48	98.03
S_7 : 120 %	30	29.98	99.69
S_8: 120 %	30	30.12	100.34
S_9: 120 %	30	29.96	99.68
		Mean =	99.29
		SD=	0.8195
		%RSD =	0.82533

Table 3: Intraday precision data of glipizide.

SI.No	Intraday Precision Conc.(mcg/ml)	Absorbance 1	Absorbance 2
1	20	0.878	0.877
2	20	0.877	0.876
3	20	0.879	0.878
4	20	0.878	0.877
5	20	0.876	0.879
6	20	0.879	0.877
	Mean =	0.877833	0.877333
	SD =	0.001169	0.001033
	%RSD =	0.133174	0.11772

Table 4: Interday precision data of glipizide.

Sl.No.	Conc.(mcg/ml)	Day 1	Day 2
1	20	0.878	0.879
2	20	0.876	0.879
3	20	0.878	0.877
4	20	0.879	0.876
5	20	0.877	0.876
6	20	0.876	0.877
	Mean =	0.877833	0.877333
	SD =	0.001211	0.001366
	%RSD =	0.138039	0.155729

Linearity

Linearity was performed to find out whether test results were proportional to the concentration of analyte in samples in a given range. The drug obeyed the Beer's law and showed good correlation. The response was found to be linear over a concentration range of 0.2-60 µg/ml. Beer-Lambert's law is applicable in this concentration. The correlation coefficient was found to be 0.999 which is within the acceptance criteria. The linearity curve of glipizide is shown in figure 2.

OPTICAL CHARACTERISTICS

The various optical characteristics such as sandell's sensitivity, molar extinction coefficient, correlation coefficient, slope, intercept and standard deviation of intercept e.t.c are found out at λ_{max} 230 nm. Here Beer's Law limit (µg/mL) of 0.2 -50.0 are maintained. Finally all the results are shown in table 5.

Table 5: Optical characteristics and validation parameters

Optical characteristics and validation parameters	**Values**
λ_{max}	230 nm
Beer's Law limit (µg / mL)	0.2-50.0
Sandell's sensitivity (µg / nm2/0.001abs unit)	2.439×10^{-3}
Molar extinction coefficient (mole-1 nm-1)	1.8245×10^{4}
Correlation coefficient	0.999
Regression Equation	y = 0.041x + 0.011
Slope (m)	0.041
Intercept (c)	0.011
Precision (% RSD)* intraday and interday Accuracy (% RSD)*	0.133174 & 0.138039 0.82533

RESULTS AND DICUSSION

The proposed method for glipizide is found to be simple, selective, reproducible as well as identifiable with effective precision and accuracy. The method was proved to be superior to other sophisticated analytical methods as it is cost effective and simple. From the above study it has been observed that the drug obeyed Beer's law and showed good correlation. Beer-Lambert's law is applicable in the concentration range 0.2-60 µg/mL. The regression equation was found to be Y = 0.041x + 0.011. The correlation coefficient was found to be 0.999. Accuracy of the method was performed in order to ensure closeness of agreement between true value and reference value in three levels each and precision studies is carried out in order to find out by using preparation of standard to ensure that the analytical solution was working properly and giving precise and optimum results. The percentage of recovery for glipizide is carried out and results was found within the acceptance limit of 98.0-102.0%. The % RSD was 0.82533 which is within the limit of NMT 2.0%. The RSD obtained from precision studies of six replicate injections of intraday and interday precision were well within the acceptance limit of NMT 2.0%. The accuracy and precision values were

determined which are less than 2% that indicate good accuracy and precision values. The percentage of assay for two types of marketed formulations is estimated properly and the % assay was found at 99.87% and 100.2%, which were in the acceptance limit of 98.0 to 102.0%. The RSD was within the limit of NMT 2.0%. The low % RSD values in the recovery studies indicate that there is no interference due to excipients used in the formulation. Hence, it is concluded that the proposed method in phosphate buffer pH 3.8 can be used as an alternative method to the reported ones for routine determination of selected drugs under the study as this method is found to be simple, precise and accurate for the analysis of glipizide in bulk and pharmaceutical dosage forms which is also useful as a quality control tool in pharmaceutical industries.

CONCLUSIONS

It has been concluded that the developed method is considered as simple, accurate, precise and economical due to this method does not required any expensive organic solvents. This above developed method used only water with little amount of salt {disodium hydrogen phosphate} is added for preparation of phosphate buffer which is very convenient for analysis as compared to other sophisticated analytical methods like HPLC, GC, etc. This method found to be reproducible for UV spectro-photometric determination of glipizide from pharmaceutical formulation which also can be successfully implemented for the routine analysis of glipizide in bulk and pharmaceutical dosage forms. Hence the proposed purpose of the present investigation was successfully achieved.

CONFLICT OF INTEREST

The authors have no conflict of interest.

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REFERENCES

1. Ambrogi, V; Bloch, K; Daturi, S; Logemann, W; Parenti, MA and Tommasini, R (1972) New oral anti diabetic drugs. Arzneimittel for schung 22: 542–544.

2. Darshana, MK and Bhavesh, PH (2012) "Simultaneous determination of metformin hydrochloride and glipizide in tablet formulation by HPTLC" ***J Liquid Chromatography and Related Technologies*** 35: 28-39.
3. Dhawan, S and Singla, AK (2003) "High Performance liquid chromatographic analysis of glipizide:application to *in vitro* and *in vivo* studies", ***J Chromatogr Sci*** 41: 295-300.
4. https://pubchem.ncbi.nlm.nih.gov/compound/glipizide#section=Top
5. https://www.accessdata.fda.gov/drugsatfda_docs/label/2013/021460s010lbl.pdf
6. https://www.drugbank.ca/drugs/DB01067
7. ICH Guidelines Q2 (R1) (2005) "Validation of analytical procedures: text and methodology," in ***ICH Harmonized Tripartite Guidelines***.
8. International conference on Harmonization (1994) Guidance for Industry In; Q2A Text on Validation of Analytical Methods, Switzerland; IFPMA, 1-4.
9. International conference on Harmonization, (1996) Guidance for Industry In; Q2B Validation of Analytical Procedures, Methodology, Switzerland; IFPMA; 1-8.
10. Jamzad, S and Fassihi, R (2006) "Development of control release low dose class II drug glipizide." ***Int J Pharm*** 312: 24-32.
11. Jamzad, S and Fassihi, R (2006) "Role of surfactant and Ph on dissolution properties of fenofibrate and glipizide A technical note." ***AAPS pharm Sci tech*** 7: E1-E6.
12. Kavalali, G; Tuncel, H; Goksel, S and Hatemi, HH (2003) Hypoglycemic activity of *Urtica pilulifera* in streptozotocin-diabetic rats. ***J Ethnopharmacol*** 84: 241–245
13. Lahoti, SR; Puranik, PK; Heda, AA and Navale, RB (2010) "Development and validation of RP-HPLC method for analysis of glipizide in guinea pig plasma and its application to pharmacokinetic study," ***Int J of Pharm Tech Research*** 2: 1649–1654,
14. Lebovitz, HE and Feinglos, MN (1983) Mechanism of action of the second-generation sulfonylurea Glipizide. ***Am J Med*** 75: 46–54.
15. Lin, ZJ; Desai-Krieger, D and Shum, L (2004) "Simultaneous determination of glipizide and rosiglitazone unbound drug concentrations in plasma by equilibrium dialysis and liquid chromatography- tandem mass spectrometry," ***J Chromatogr B*** 801: 265–272,
16. Merck Research Laboratories (2001) The Merck Index, Merck, Whitehouse Station, NJ, USA, 13th edition.
17. Norris, E (1979) "Glipizide, a new second-generation sulfonylurea." ***Adv Exp Med Biol*** 11: 427
18. Rahila, Shaikh, R and Karigar, A (2010) "Reverse phase high performance liquid chromatographic method for the analysis of glipizide in pharmaceutical dosage forms", ***Int J Research in Ayurveda & Pharmacy*** 1: 455-458.
19. Rao, UKB and Nikalje, AP (2010) "Determination of Glipizide, Glibenclamide and Glimeperide in a Tablet Dosage Form in the Presence of Metformin Hydrochloride by

Ion Pair –Reversed Phase Liquid Chromatographic Technique", ***J Anal Bioanal Techniques*** 1: 105.

20. Shammi, G; Rai, JK; Narang, RK and Rajesh KS (2010) "Sulfonyl ureas for antidiabetic therapy, an overview for glipizide." ***Int J Pharmacy Pharm Sci*** 2.
21. Shuman CR (1983) Glipizide: an overview. ***Am J Med*** 75:55–59.
22. Shuman, CR (1983) "Glipizide: an overview," ***The American J of Medicine***, 75(5), part 2: 55–59.
23. Yu HN; Ho, NE; Tang, P; Francis, W and Terence, WS (2008) "To develop the simple, stability-indicating reversed-phase high-performance liquid chromatographic (RP-HPLC) method for determination of Glipizide in guinea pig plasma" ***Journal of Chromatography A*** 1: 426-434.

Correspondence Author:

Suryakanta Swain*

Southern Institute of Medical Sciences, College of Pharmacy, Mangaldas Nagar, Vijyawada Road, Guntur-522001, Andhra Pradesh, India

Contact No: +91-7702247710

E mail id: swain_suryakant@yahoo.co.

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