International Journal of Current Pharmaceutical Research

ISSN- 0975-7066 Vol 14, Issue 3, 2022

Original Article

SPECTROPHOTOMETRIC QUANTIFICATION OF GLICLAZIDE IN PHARMACEUTICAL DOSAGE FORM

DILIP M. CHAFLE*

***Department of Chemistry, Faculty of Science, Taywade College, Koradi, Nagpur (M. S.) 441111, India**
Email: dmchafle@gmail.com

Received: 20 Jan 2022, Revised and Accepted: 22 Mar 2022

ABSTRACT

Objective: A simple and sensitive spectrophotometric method has been proposed for quantification of Gliclazide in pure and dosage form.

Methods: A visible spectrophotometric methods based on the ion-pair formation of drug with the dye Cresol Red (Method A) and Bromophenol Blue (Method B) in methanol medium.

Results: A purple colour complex was formed in Method A while orange colour was obtained by Method B with maximum absorption at 510 nm and 445 nm, respectively. The Beers law was found linear over the concentration range from 30 to 200µg/ml (Method A) and from 70 to 230µg/ml (Method B) with good correlation coefficients 0.9918 and 0.9916 respectively. The molar extinction coefficient were 0.1326 x 10^4 L/mol/cm (Method A) and 0.1294 x 10^4L/mol/cm (Method B), LOD 0.2563, 0.4681 and LOQ 0.6394µg/ml and 0.9256 µg/ml.

Conclusion: The proposed methods were statistically evaluated for accuracy, precision and linearity in terms of standard deviation, percentage recovery, percentage error and relative standard deviation. The proposed methods can be applied in routine analytical and quality control laboratories for the quantification of Gliclazide. The methods are simple, sensitive, rapid and economical for the estimation of Gliclazide in pure and dosage forms.

Keywords: Spectrophotometric, Quantification, Gliclazide, Cresol Red, Bromophenol blue

DOI: https://dx.doi.org/10.22159/ijcpr.2022v14i3.1981 Journal homepage: https://innovareacademics.in/journals/index.php/ijcpr

INTRODUCTION

Gliclazide (GLZ) is anantidiabetic drug of second-generation. It belongs to the class sulphonylurea. It is used as oral antihyperglycemic agent in the treatment of non-insulin-dependent diabetes mellitus [1]. It acts by stimulating β cells of the pancreas to release insulin. Gliclazide also has anti-platelet adhesive activity and reduces levels of free radicals, thereby preventing vascular complications [2].

Gliclazide is a white coloured powder chemically known by the name 1(Hexahydrocyclopenta(c)pyrrol-2(1H)yl)-3[(4-methyl phenyl)sulphonyl] urea (fig. 1) [3].

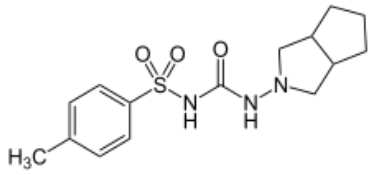

Fig. 1: Chemical structure of gliclazide

The extensive literature survey reveals that there are various methods has been reported for the quantitative determination of GLZ such as RP-HPLC [4], HPLC [5-7], tandem mass spectrometry [8] which required costly instrumentation. The other methods are simultaneous spectrophotometric methods [2, 9-13], UV spectrophotometric methods [14-16], and spectrofluorimetric [17] are lengthy and time-consuming methods. Some spectrophotometric methods [18, 19] are reported which involves the ternary complex formation and solvent extraction in which accuracy may not be obtained. There is no direct spectrophotometric method working in the visible region is reported in the literature.

In the present study, the aim of the work is to develop a simple, sensitive and economical spectrophotometric methods operating in visible range of spectra for the quantitative determination of GLZ in pure and dosage form. The proposed methods are based on the ability of drug GLZ to form coloured ion pair complex with the dye Cresol red and Bromophenol blue [20] in methanol.

MATERIALS AND METHODS

Instrument

A visible spectrophotometer EQ 882 of Equiptronic (India) with a bandwidth of 1.0 nm, equipped with 10 mm matched quartz cells were used for all spectral measurements.

Reagent

All the chemicals were of analytical grade and all the solutions were prepared in distilled methanol. The pharmaceutical preparation of GLZ in the form of tablets viz Gliclataj 80 mg (Taj Pharmaceuticals Ltd, Ahmedabad, India), Zidesal-80 (Salius Pharma, Mumbai, India) and Glizid-80 (Panacea Biotec Ltd, Chandigarh, India) were procured from local market. Pure GLZ was obtained from Sigma.

Cresol red (CR) solution

1 x 10^{-3} M solution of cresol red dye (Merck) was prepared by dissolving 0.382 g in 50 ml methanol filter it by using Whatman filter paper 40 and diluted to 100 ml by methanol. It was further diluted 10 times by methanol to get desired concentration.

Bromophenol blue (BPB) solution

1x 10^{-3} M solution of bromophenol blue dye (Merck) was prepared by dissolving 0.670 g in 50 ml methanol. After filtration using Whatman filter paper 40 it was diluted to 100 ml by methanol. It was further diluted by methanol to get the appropriate concentration.

Preparation of standard stock solution

Standard stock solution of GLZ (100µg/ml) was prepared by dissolving 100 mg of pure GLZ drug in 50 ml methanol by constant stirring on a magnetic stirrer for 30 min and then volume made up

to 100 ml by methanol. This solution was further used to get working standard solution of the appropriate concentration.

Preparation of sample solution

Twenty tablets of (Gliclataj 80 mg, Zidesal-80, Glizid-80) were weighed and pulverized. An amount equivalent to 100 mg of pure drug was weighed accurately. The powder sample was transferred to 100 ml volumetric flask and 50 ml methanol was added. The solution was stirred constantly for 30 min on magnetic stirrer. After filtering the solution using Whatman filter paper number 40, the volume was made up to 100 ml by methanol. This solution was further used to get a solution of the appropriate concentration.

General recommended procedure

Method A-An aliquot ranging from 0.1 to 2.5 ml of working standard solution of GLZ was transferred into a series of 10 ml volumetric flasks. A volume of 2.5 ml of CR solution was added. The flasks were kept at room temperature for 10 min and then 5 ml chloroform was added. Finally, the volume was made to 10 ml by methanol. Similarly, blank was prepared without a drug. The resulted purple-colored solution was scanned for absorbance from 400 to 800 nm on Equiptronic EQ 882 spectrophotometer against a reagent blank (methanol). A standard calibration curve was prepared by plotting absorbance against the concentration of GLZ (fig. 2). Similarly, sample solutions were analyzed. The concentration of GLZin sample solution was determined from the calibration curve.

Method B-Similar method was used as discussed above for method-A using BPB solution instead of CR solution. Anorange color was obtained in method B. A standard calibration graph was obtained for Method B (fig. 3).

RESULTS

Maximum wavelength of absorption (λ_{max})

An aliquot of 2.5 ml of working standard solution of GLZ and 2.5 ml of CR solution was transferred in 10 ml flask. The reaction mixture was kept for 10 min at room temperature and 5.0 ml Chloroform was added. The volume was made up to the mark by methanol. Similarly, blank was prepared without a drug. The resulted purple-colored solution was scanned over a visible range of spectrum on Equiptronic EQ 882 spectrophotometer against blank (fig. 4). In a similar way the maximum wavelength of absorption was determined using BPB solution (fig. 5).

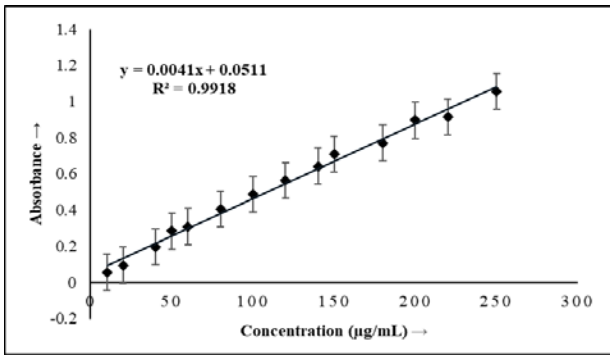

Fig. 2: Beer's calibration plot for GLZ-CR complex

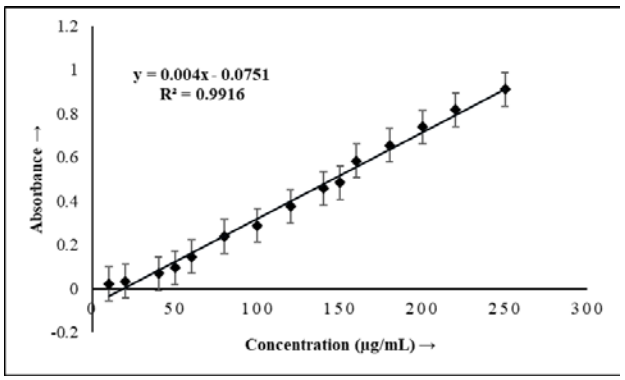

Fig. 3: Beer's calibration plot for GLZ-BPB complex

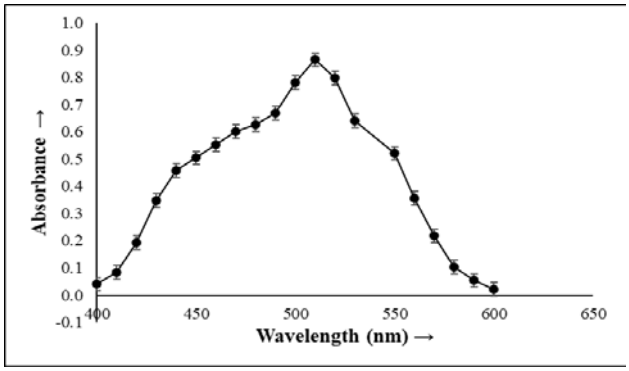

Fig. 4: Absorption spectra of GLZ-CR complex

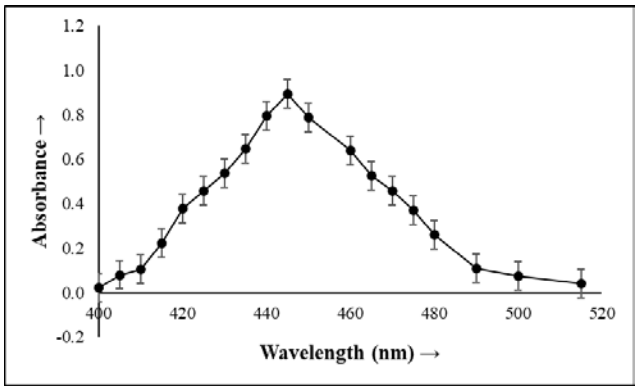

Fig. 5: Absorption spectra of GLZ-BPB complex

Linearity

A standard calibration curve was constructed by plotting the absorbance against the concentration of GLZ. The statistical parameters were given in the regression equation calculated from the calibration curve y = a+mx, where y is the absorbance, x is a concentration of GLZ in µg/ml, m is slope and a is the intercept on y-axis. The linearity was calculated by the least square regression method. The linearity of the calibration graph was proved by high value of correlation coefficient (R^2) and small value of the y-intercept of the regression equation. The linearity range of the calibration curve was found to be limiting in the range for Method-A from 30 to 200 µg/ml and for Method-B from 70 to 230 µg/ml concentration of GLZ. The molar absorptivity and Sandel's sensitivity of the resulting color complex was calculated and found to befor Method-A0.1326 x 10^4 L/mol/cmand0.2102µg/$cm^2$and for Method-B 0.1294x 10^4 L/mol/cm and 0.3709µg/cm^2 (table 1).

Table 1: The spectral characteristics of proposed methods

Parameters	Method A	Method B
Maximum Wavelength of Absorbance λ_{max} (nm)	510	445
Color of the complex	Purple	Orange
Beer's law limit (µg/ml)	30–200	70-230
Molar Absorptivity (L/mol/cm) x 10^4	0.1326	0.1294
Sandel's Sensitivity (µg/cm^2)	0.2102	0.3709
Regression Equation*		
Intercept (a)	0.0511	-0.0751
Slope (m)	0.0041	0.0040
Regression Coefficient (R^2)	0.9918	0.9916

*y = a+mx, where x is the concentration of GLZ in µg/ml, y is the absorbance units

Table 2: The accuracy data for recovery study of GLZ by proposed methods (A and B)

Method	Amount of tablet powder (mg)	Amount of pure drug added (mg)	Amount found	SD*	% Recovery	RSD
A	80	20	99.85	±0.074	99.85	0.074
	80	40	119.49	±0.097	99.56	0.081
	80	60	139.37	±0.135	99.55	0.097
B	80	20	99.78	±0.056	99.78	0.056
	80	40	119.59	±0.082	99.66	0.069
	80	60	138.41	±0.147	98.86	0.106

*For five determinations, SD–Standard Deviation, RSD–Relative Standard Deviation

Accuracy

The accuracy of the proposed methods was checked by carrying recovery study by applying the standard addition method. A known amount of standard GLZ (25, 50 and 75%) was added to the pre-analyzed samples. The recovery studies were caried at each level for five determinations (table 2).

Precision

The intra-day precision was determined by repeating the experiment three times in a day and inter-day precision was checked by carrying the same experiment on three consecutive days using proposed methods. The solutions containing 80, 100 and 120 µg/ml of GLZ were subjected to the proposed methods of analysis. The recoveries of the drug obtained were noted as shown in table 3.

LOD and LOQ

Limit of detection (LOD) and limit of quantification (LOQ) were calculated based on the standard deviation of the analytical response and the slope of the calibration curve using the equations LOD = 3.3 σ/S and LOQ = 10 σ/S, where σ is the SD of the response and S is the slope of the calibration curve and the LOD, LOQ values are shown in table 3.

Application to a pharmaceutical preparation

The proposed methods have been successfully applied for the determination of GLZ in pharmaceutical preparations. A suitable aliquots of sample solutions of Gliclataj 80, Zidesal-80, Glizid-80 tablets were taken in linearity range and similarly treated as described in the general recommended procedure. The recovery

study for five replicate determinations for label claim of the drug were tested by proposed methods in the samples. The percentage recovery of the drug in the sample was up to 99.80 %, the percentage error ranging from 0.199 to 1.282, the standard deviation (SD) was between±0.3946 and±0.9487 and relative standard deviation (RSD) was from 0.49 to 1.20 (table 4). It shows that the proposed method has good applicability. The result of the estimation of the drug in the sample was found to be in good agreement with label claim which indicates the absence of interference of excipients.

Table 3: The precision data of the proposed methods (A and B)

Parameters	Method A	Method B
Limit of detection (ug/ml)	0.2563	0.4681
Limit of quantification	0.6394	0.9256
Intra-day precision (% RSD*)	0.1875	0.1579
	0.2248	0.2573
	0.2764	0.2358
Inter-day precision (% RSD*)	0.2846	0.2643
	0.3187	0.3284
	0.3581	0.3952

*For n = 3 determinations

Table 4: Quantification of GLZ in dosage form

Tablet	Make	Labeled claim (mg)	Amount found (mg)	Recovery %	Error %	SD*	RSD*
Gliclataj 80	Taj Pharma	80	79.258	99.073	0.927	±0.4872	0.6147
Zidesal-80	Salius Pharma	80	79.841	99.801	0.199	±0.3946	0.4942
Glizid-80	Panacea Biotec	80	78.974	98.718	1.282	±0.9487	1.2013

*For five determinations, SD–Standard Deviation, RSD–Relative Standard Deviation

DISCUSSION

CR and BPB are anionic dyes can form ion pair complex with the positively charged nitrogen-containing molecule of Gliclazide. The colour of the ion-pair complex is due to the opening of the lactoid ring and subsequent formation of quinoid group. Gliclazide in presence of a proton donor such as methanol form positively charge protonated Gliclazide. It forms purple and orange coloured ion-pair complexes with anionic form of Cresol red and Bromophenol blue, respectively. The reaction scheme is as shown below.

$$GLZ^{+} + CR^{-} \xrightarrow{Methanol} [GLZ^{+} - CR^{-}]$$

$$GLZ^{+} + BPB^{-} \xrightarrow{Methanol} [GLZ^{+} - BPB^{-}]$$

The resultant purple and orange color complex were shows a maximum wavelength of absorbance (λ_{max}) at 510 and 445 nm in visible spectrum. This colored complex formed was stable for more than 24 h.

CONCLUSION

This article describes the application of simple visible spectrophotometric technique by using ion pair complex formation reaction between drug and dye for the quantification of GLZ in bulk and tablet dosage form. The proposed method is simple, sensitive with reasonable precision and accuracy in the visible range. It is further found that the percentage recovery is good enough so that the proposed method is free from excipient interference. It is applicable to detect GLZ even at very low concentration level. Therefore, the proposed method can be recommended for the routine estimation of Gliclazide in bulk as well as pharmaceutical preparations.

ACKNOWLEDGEMENT

The author is thankful to the Principal of Taywade College, Koradi for providing an infrastructural facility to carry the research work.

FUNDING

Nil

AUTHOR CONTRIBUTION

The author Dr. Dilip M. Chafle has himself generated the idea and carry out the experiment. He interpreted the data and draft the manuscript. He has also checked spelling, and plagiarism and finally submitted the manuscript.

CONFLICTS OF INTERESTS

Declared none

REFERENCES

1. Indian Pharmacopoeia. Vol. 2. New Delhi: Government of India, Ministry of Health and Welfare; 2010. p. 1416-17.
2. Usharani N, Keerthana K, Sarika M. Development and validation of a novel UV-derivative spectroscopic method for estimation of gliclazide tablets. World J Pharm Res. 2015;4(11):1564-72.
3. Merck. Index. An encyclopaedia of chemical drugs and BioLogicals. 12th. ed. Vol. 9811; 1996.
4. Ravi Kumar BVV. A RP-HPLC method development and validation for the estimation of gliclazide in bulk and pharmaceutical dosage forms. J Appl Pharm Sci. 2013;3(4):59-62.
5. Baghel US, Shrivastava B, Kumar D, Tiwari AP. Gradient HPLC method development and validation for simultaneous estimation of rosiglitazone and gliclazide. Asian Pac J Trop Dis. 2012;2:S756-60. doi: 10.1016/S2222-1808(12)60259-X.
6. Rouini MR, Mohajer A, Tahami MH. A simple and sensitive HPLC method for determination of gliclazide in human serum. J Chromatogr B Anal Technol Biomed Life Sci. 2003;785(2):383-6. doi: 10.1016/s1570-0232(02)00951-0, PMID 12554153.
7. AbuRuz S, Millership J, McElnay J. The development and validation of liquid chromatography method for the simultaneous determination of metformin and glipizide, gliclazide, glibenclamide or glimperide in plasma. J Chromatogr B Analyt Technol Biomed Life Sci. 2005;817(2):277-86. doi: 10.1016/j.jchromb.2004.12.018, PMID 15686996.
8. Agrawal YK, Gogoi PJ, Manna K, Bhatt HG, Jain VK. A supercritical fluid chromatography/tandem mass spectrometry method for the simultaneous quantification of metformin and gliclazide in human plasma. Indian J Pharm Sci. 2010;72(1):50-7. doi: 10.4103/0250-474X.62231, PMID 20582190.
9. Loni AB, Ghante MR, Sawant SD. Simultaneous UV spectrophotometric method for estimation of gliclazide and metformin hydrochloride in tablet dosage form. Pharm Chem. 2012;4(3):854-9.
10. Moitra K, Murthy PN, Mishra US. Simultaneous spectrophotometric analysis of rosiglitazone maleate and

gliclazide in bulk drug and pharmaceutical formulation. Pharm Sin. 2012;3(2):170-6.

11. Dadhania KP, Nadpara PA, Agrawal YK. Development and validation of a spectrophotometric method for simultaneous estimation of gliclazide and metformin hydrochloride in bulk and tablet dosage form by simultaneous equation. Int J Pharm Sci Res. 2011;2(6):1559-63.
12. Reichal CR, Rao MG. Devlopment and validation of a spectrophotometric method for simultaneous estimation of gliclazide and sitagliptin phosphate monohydrate in bulk and pharmaceutical dosage form. Int J Pharm Pharm Sci. 2015;7(6):372-6.
13. Dhabale PN, Seervi CR. Simultaneous UV spectrophotometric method for estimation of gliclazide and metformin hydrochloride in tablet dosage form. Int J Chem Tech Res. 2010;2(2):813-7.
14. Pinderjit S, Kumar R, Harinder S. Application of UV spectrophotometric method for analysis of gliclazide in pharmaceutical dosage forms. Int J Pharmacy Pharm Sci. 2011;3(4):259-60.
15. Jamadar SA, Mulye SP, Karekar PS, Pore YV, Burade KB. Development and validation of UV spectrophotometric method for the determination of gliclazide in tablet dosage form. Pharm Chem. 2011;3(4):338-43.
16. Dhole SM, Khedekar PB, Amnerkar ND. Application of UV spectrophotometric and HPLC method for simultaneous determination of rosiglitazone maleate and gliclazide in combined tablet dosage form. Int J Pharm Chem Res. 2012;1(1):39-48.
17. El-Enany N. Spectrofluorimetric and spectrophotometric determination of gliclazide in pharmaceuticals by derivatization with 4-chloro-7-nitrobenzo-2-oxa-1,3-diazole. J AOAC Int. 2003;86(2):209-14. doi: 10.1093/jaoac/86.2.209, PMID 12723907.
18. Revathi R, Saravanan VS, Mohan RP, Ethiraj T, Ganesan V. Spectrophotometric estimation of gliclazide in bulk and pharmaceutical dosage forms. Int Res J Pharm. 2010;1(1):277-81.
19. El-Enany N. Spectrophotometric determination of gliclazide in pharmaceuticals and biological fluids through ternary complex formation with eosin and palladium (II). Farmaco. 2004;59(1):63-9. doi: 10.1016/j.farmac.2003.08.007, PMID 14751318.
20. Chafle DM, Awale LS. Development and validation of direct spectrophotometric method for the estimation of glimepiride. J Pharm Res Int. 2021;33(33A):176-86. doi: 10.9734/jpri/2021/v33i30A31629.