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Extractive Spectrophotometric Determination of Pioglitazone Hydrochloride Using Both Acidic and Basic Dyes

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Four simple extractive spectrophotometric methods have been developed for the estimation of Pioglitazone hydrochloride in pure and pharmaceutical dosage forms. These methods are based on the formation of ion association complexes of the drug with tropaeolin-OOO or woolfast blue or saffranin-O or methylene blue; the complexes were extracted with chloroform and the absorbances of the chloroform layer were measured at 487 nm, 590 nm, 520 nm and 650 nm respectively. These methods have been statistically evaluated and are found to be precise and accurate.

Key Words: Spectrophotometric determination, Pioglitazone hydrochloride, Acidic and basic dyes.

INTRODUCTION

Pioglitazone hydrochoride (PGH)[1–3] is an antidiabetic drug. Chemically PGH is 2,4-thiazolidine dione, 5-[[4-[2-(5-ethyl-2-pyiridinyl)ethoxy]phenyl]methyl]. It is potent and highly selective agonist for peroxisome proliferator-activated receptor-gamma (PPARγ). The literature survey reveals that few HPLC[4–7] methods are reported in human plasma and serum. There is no analytical report for the estimation of PGH using visible spectrophotometry. The proposed methods are based on the formation of ion association complexes of the drug with acid dyes such as tropaeolin-OOO (TP-OOO, method A) or woolfast blue (WFB, method B) or with basic dyes such as safranin-O (SFN-O, method C) or methylene blue (MTB, method D).

EXPERIMENTAL

Instrumentation

Spectral and absorbance measurements were made on Systronics UV-Visible spectrophotometer-117 with 10 mm matched quartz cells.

Reagents

All the chemicals used were of analytical grade. Aqueous dye solutions TP-OOO (Loba, 0.5% w/v, 1.43×10^{-2} M), WFB (Loba, 0.2% w/v, 3.26×10^{-3} M), SFN-O (Fluka, 0.2% w/v, 5.714×10^{-3} M). MTB (Fluka, 0.2% w/v,

6.25×10^{-3} M) were prepared in double distilled water. All these solutions were treated with chloroform to remove any chloroform-soluble impurities if present.

HCl (0.1 M): Prepared by diluting 8.5 mL of conc. hydrochloric acid to 1000 mL with distilled water.

Glycine buffer solution (pH 1.5): Prepared by mixing 289 mL of glycine solution (37.52 g of glycine and 29.24 g of NaCl were dissolved in 500 mL of distilled water) with 711 mL of 0.1 M HCl and pH of the solution was adjusted to 1.5.

Ammonia-Ammonium chloride buffer solution (pH 9.8): Prepared by mixing 7 g of ammonium chloride with 56.8 mL of liquid ammonia solution and diluted to 100 mL with distilled water and pH was adjusted to 9.8.

Preparation of standard solution: Accurately weighed 100 mg of PGH and dissolved in 35 mL of 0.1 N HCl and diluted to 100 mL with distilled water to get 1 mg/mL stock solution. 5 mL of the stock solution was further diluted with the same solvent up to 100 mL to obtain a working standard solution of 50 μg/mL.

Preparation of sample solutions: Twenty tablets were accurately weighed and finely powdered. The powder equivalent to 100 mg of PGH was dissolved in 35 mL of 0.1 N HCl. These solutions were filtered and the residue was washed with water and volume made up to 100 mL. 5 mL of the stock solution was further diluted with the same solvent up to 100 mL to obtain a working standard solution of 50 μg/mL.

Assay procedures

Methods A and B

Aliquots of standard solutions 0.5–2.5 mL (method A) or 0.25–1.25 mL (method B) were placed separately in a series of 125 mL separating funnels, 1 mL of 0.1 N HCl (method A) or 6 mL of pH 1.5 (method B) and 1.0 mL of TPOOO (method A) or 2.0 mL of WFB (method B) were added. The total volume of aqueous phase in each funnel was adjusted to 10 mL with distilled water, and then 10 mL of chloroform was added; the contents were shaken for 2 min and allowed to separate. The chloroform layer was collected and the absorbance was measured at 487 nm (method A) or at 590 nm (method B) against reagent blank. Both the coloured species were stable for 4 h. The amount of PGH in a sample solution was obtained from the calibration curve.

Methods C and D

Aliquots of standard drug solution (0.5–2.5 mL) for method C or (0.25–1.25 mL) for method D and 1.0 mL of pH 9.8 buffer solutions were added separately in a series of 125 mL separating funnels. Volumes of 1.5 mL of safranin-O (method C) or 0.5 mL of MTB (method D) were added respectively. The total volume of aqueous phase in each funnel was adjusted to 10.0 mL with distilled water. Then 10 mL of chloroform was added to each separating funnel and the contents were shaken for 2 min and allowed to separate. The chloroform layer was collected and the absorbance was measured at 520 nm (method C) or at 650 nm (method D) against reagent blank. Both the coloured species were stable for

2 h. The amount of PGH in a sample solution was obtained from the calibration curve.

RESULTS AND DISCUSSION

The optical characteristics such as Beer's law limits, Sandell's sensitivity, molar extinction coefficient, per cent relative standard deviation (calculated from the eight measurements containing 3/4th of the amount of the upper Beer's law limits), were calculated for both the methods and the results are summarized in Table-1. Regression characteristics like standard deviation of slope (S_b), standard deviation of intercept (S_a), standard error of estimation (S_e), % range of error (0.05 and 0.01 confidence limits) and detection limit were calculated for all these methods and are shown in Table-1.

TABLE-1
OPTICAL CHARACTERISTICS AND PRECISION OF THE PROPOSED METHODS

Parameter	A	B	C	D
λ_{max} (nm)	487	590	520	650
Beer's law limits (μg mL^{-1})	2.5–12.5	1.25–6.25	2.5–12.5	1.25–6.25
Detection limits (μg mL^{-1})	0.1214	0.0550	0.1040	0.0614
Molar absorptivity (L mol^{-1} cm^{-1})	1.68×10^4	3.28×10^4	1.73×10^4	4.11×10^4
Sandell's sensitivity (μg cm^{-2}/0.001 absorbance unit)	0.023	0.011	0.022	0.009
Regression equation (Y = a + bc)				
Slope (b)	4.3×10^{-2}	8.3×10^{-2}	4.4×10^{-2}	1.0×10^{-1}
Standard deviation of slope (S_b)	2.1×10^{-4}	3.7×10^{-4}	1.8×10^{-4}	5.1×10^{-4}
Intercept (a)	-5.0×10^{-4}	-1.2×10^{-3}	-1.2×10^{-3}	6.0×10^{-4}
Standard deviation of intercept (S_a)	1.7×10^{-3}	1.5×10^{-3}	1.5×10^{-3}	2.1×10^{-3}
Standard error of estimation (S_e)	1.6×10^{-3}	1.4×10^{-3}	1.4×10^{-3}	2.0×10^{-3}
Correlation coefficient (r)	0.9999	0.9999	0.9999	0.9999
Relative standard deviation (%)	0.327	0.511	0.460	0.388
% Range of error (Confidence limits)*				
0.05 level	0.274	0.427	0.385	0.325
0.01 level	0.405	0.632	0.570	0.480
% Error in bulk samples†	0.087	0.090	0.198	0.167

*Average of eight determinations
†Average of three determinations

Commercial formulations (tablets) containing PGH were successfully analyzed by the proposed methods. The values obtained by the proposed method were compared with reference method (UV method established in our laboratory). As an additional demonstratration of accuracy, recovery experiments were performed by adding a fixed amount of the drug to the pre-analyzed formulations. These results are summarized in Table-2. There is no interference in the proposed analytical methods. In conclusion the proposed extractive spectrophotometric methods for the estimation of PGH are simple, sensitive, cheap, accurate and have

application in the routine quality control analysis and quantitative determination of pioglitazone hydrochloride and its pharmaceutical preparations.

TABLE-2
ASSAY AND RECOVERY OF PGH IN DOSAGE FORMS

Method	Pharmaceutical formulations	Labelled amount (mg)	Amount found (mg)		% Recovery
			Proposed method	Reference method	
A	Tablet I	30	29.65	29.85	98.8
	Tablet II	45	45.01	45.04	100.02
B	Tablet I	30	29.75	29.95	99.16
	Tablet II	45	44.96	45.02	99.91
C	Tablet I	15	14.94	14.98	99.6
	Tablet II	30	29.97	29.98	99.9
D	Tablet I	15	15.02	24.65	100.13
	Tablet II	30	30.85	25.65	102.83

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