ejpmr, 2017,4(1), 192-200

SJIF Impact Factor 3.628

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Review Article

ISSN 2394-3211

EJPMR

A REVIEW ARTICLE ON LITERATURE REVIEW OF CHROMATOGRAPHIC, SPECTROPHOTOMETRIC AND OTHER METHODS FOR QUANTITATIVE ESTIMATION OF TERAZOSIN HYDROCHLORIDE AND TOLTERODINE TARTRATE IN PURE AND COMBINATION WITH OTHER DRUGS.

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Article Received on 08/11/2016 **Article Revised on 28/11/2016** **Article Accepted on 19/12/2016**

ABSTRACT

Vanavi, Shah and Maheshwari: Review literature of Terazosin Hydrochloride and Tolterodine Tartrate This Article enlightens area in which the works already have been done for Terazosin Hydrochloride, a selective α1 receptor antagonist and Tolterodine Tartrate, antimuscarinic drug. Terazosin have effective approach towards symptoms and conditions of benign prostatic hyperplasia, for quantitative determination of Terazosin, Spectroscopic methods (UV, Visible) Chromatographic method (HPLC, HPTLC) and other methods (LC/MS/MS) were performed and successfully quantified. Similarly Tolterodine have effective approach for symptoms of benign prostatic hyperplasia such as urinary urgency.

KEYWORDS: Terazosin Hydrochloride, Tolterodine Tartrate, Literature Review, Analytical methods, Spectrophotometric method, Chromatographic methods, HPLC.

INTRODUCTION

Terazosin belongs to selective alpha –antagonist with Mol.mass:459.92g/mol**,** It is effectively works in treatment of symptoms of benign prostatic hyperplasia. It can be indicated for patient with hypertension and prostate enlargement because it lowers blood pressure. It blocks the action of adrenaline on smooth muscle of the bladder and the blood vessel walls. Alpha 1 Receptors leads contraction and hypertrophic growth of smooth muscle cells. It Works by Alpha1 receptors are coupled with G proteins. Three alpha 1 receptors subtype have been identified: they are alpha 1 A, alpha 1 B, alpha 1 D. Terazosin is first to show selectivity for alpha 1 A receptor. All alpha receptors maintain vascular tone. The α_{1A}-receptor manages basal vascular tone; the α_{1B}-receptor mediates the vasocontrictory effects of exogenous α_1-agonists. Activation of α_1-receptors activates G_q-proteins, which results in intracellular stimulation of phospholipases C, A_2, and D. This results in mobilization of Ca^{2+} from intracellular stores, activation of mitogen-activated kinase and PI_3 kinase pathways and subsequent vasoconstriction. Pharmacological effect of Terazosin is inhibition of α1A receptor activation. Thus it will produce vasculature and prostate muscle relaxation, decreased blood pressure and improved urinary outflow in symptomatic benign prostatic hyperplasia.

LITERATURE REVIEW OF TERAZOSIN HYDROCLORIDE.

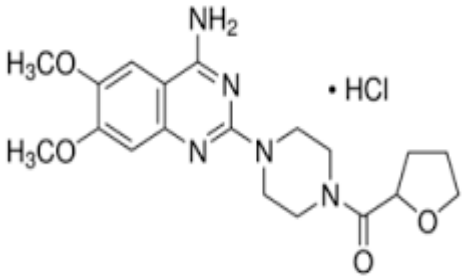

Figure: 1 Chemical Structure of Terazosin Hydrochloride.

1.1 Official methods for estimation of Terazosin Hydrochloride

Terazosin hydrochloride is official in United State pharmacopoeia (USP29 NF24, 2005) and Indian Pharmacopeia-2014.

TABLE 1.1: OFFICIAL METHODS FOR ESTIMATION OF TERAZOSIN[1-2]

Sr. No.	DRUG	METHOD	DESCRIPTION	Ref. No.
1	Terazosin Hydrochloride (USP29)	Liquid chromatography	**Detection Wavelength:** 254nm **Mobile Phase:** Citrate Buffer: Acetonitrile (1685:315 v/v) **Stationary Phase:** Stainless Steel Column 4.6×25mm packed to porous silica **Flow Rate**: 1.0 ml/min	[1]
2	Terazosin hydrochloride (IP 2014)	Potemtiometric method	**Titrate**: 0.3 gm of mixture+ 5ml of 0.01MHCl+50ml methanol **Titrate with :** 0.1 M NAOH	[2]

1.2 Reported methods for estimation of Terazosin Hydrochloride

TABLE 1.2 REPORTED SPECTROPHOTOMETRIC METHOD[3-12]

Sr. No.	DRUG	METHOD	DESCRIPTION	Ref. No.
1	Terazosin Hydrochloride in Bulk and formulation.	Spectrometric Method	**Wavelength:**250 nm **Solvent:** Methanol **Linearity Range:**2-14 µg/ml **Correlation Coefficient (R^2):** **LOD:** 1.5971 **LOQ:** 15.97137	[3]
2	Terazosin Tablet	Diazotoazotization with 1%sodium nitrite and HCL followed by coupling with β napthol in 4% NAOH	**Wavelength :** 560nm **Linear Range:** 1-10µg/ml **LOD- -** **LOQ**-1µG/ml	[6]
3	Terazosin Tablet	Fluorimetric: Dilution in methanolic 0.1N H_2SO_4	**Wavelength:**246 and 382 nm **Linearity Range:** 25-150ng/ml **LOD:** - **LOQ:** 25ng/ml	[7]
4	Terazosin in Urine and Plasma	Fluorimetric: precoancentrating Terazosin by microextracion solvent	**Detection Wavelength:**376 and 330 nm **Linearity Range:** 0.1-115µg/L **LOD:** 0.027µg/ml **LOQ:** -	[8]
5	Terazosin and Bovine serum albumin interactions.	Spectrofluorimetric.	**Wavelength:** 280/413 nm **Linearity Range:** 0-9×10-6/mol **LOD:** 0.21mg/l **LOQ:** -	[9]
6	Terazosin Tablet Terazosin Tablets and urine samples.	Spectrofluorimetric Slit width 1.5nm slit width 5nm	**Wavelength: ex -**332 and **em-**382 nm **Linearity Range:** $1\times10^{-5}$to 7 µg/ml **LOD:** 3.04×10^{-4}µg/ml **LOQ:** 1×10^{-3}µg/ml **LOD:** 1.11×10^{-5}µg/ml **LOQ:**3.7×10^{-5}µg/ml	[10]
7	Terazosin Determination in presence of degradation product.	A. First and second derivative spectra study. B. Reaction with cloranil. C. Reaction of drug with mercurochrome D. iron-pair salt of drug and bromocresol purple. E. Fluorimetric.	**a.Wavelength:**340 and 345 nm **Linearity Range:** 4-18µg/ml **b. Wavelength:**340 nm **Linearity Range:** 24-45µg/ml **c. Wavelength:**543 nm **Linearity Range:** 4-12µg/ml **d. Wavelength:**412nm **Linearity Range:** 4-20µg/ml **e. Wavelength**: λ_{ex} 390/ λ_{em} 382nm **Linearity Range:** 0.025-0.1µg/ml	[11]
8	Terazosin pure and tablet.	Ion pair complex	**Detection Wavelength:**419,415,425,428 nm **Linearity Range:** 2-14, 1-12,1-10,5-130µg/ml	[12]
9	Terazosin hydrochloride in drug substance	Potemtiometric and Fluorimetric method	**Potemtiometric method** **Electrodes:** 2 Carbon paste ion selective **Titration:** Phophomolybdic acid and	[5]

	and tablet formulation		Phosphotungestic acid. **Response:** In Conc. Range of 1×10^{-6} -1×10^{-2} mol L^{-1}, 2×10^{-6}-1×10^{-2}mol L^{-1} **Slope:** 58.4±0.35(By PMA),57.3±0.23 mV $Decade^{-1}$(By PTA) **pH Range:**2-6 **Low detection limit:** 8×10^{-7},6×10^{-7}mol L^{-1} **Fluorimetric method** **Method 1** **Measurement of native fluorescence** **Conc. Range:** 10-1000ng mol^{-1} **correlation coefficient:** r^2-0.9982 **LOD:** 3.87ng/ml **LOQ:**10.5ng/ml **Method 2** **By binary complex formation** **Conc. Range:** 0.5-12ng/ml **correlation coefficient:** r^2-0.9987 **LOD:** 0.198ng/ml **LOQ:**0.6ng/ml	

1.3 Summary of chromatographic method

Table 1.3 SUMMARY OF CHROMATOGRAPHIC METHOD [4,13-17]

Sr N0.	Drug	Method	Description	Ref. No
1	Terazosin Tablet	Stability indicating HPTLC	**Stationary Phase:** Silica gel precoated aluminum plate **Mobile Phase:**Chloroform:Toluene:Methanol(9:1:6) **Detection:** 254nm **Linear Range:**50-2500µg/ml **LOD:**18.06µg/ml **LOQ:**54.72µg/ml	[4]
2	Simultaneous determination with Prazosin,Alfuzosin and Doxazosin	HPTLC	**Stationary Phase:** Silica Gel Precoated Aluminum Plate. **Mobile Phase:** Cloroform:Methanol(9.5:0.5) **Detection:** 254nm **Linearity Range:** 0.8-1.2mg/ml **LOD:** 0.013mg/ml **LOQ:** 0.041mg/ml	[13]
3	Pharmacokinetic study	HPLC with fluorescence	**Stationary phase:** Column packed with Spherical Silica gel particles Chemically bonded with Octadecyl group **Mobile Phase:** 0.01M disodium hydrogen phosphate:acetonitrile:tetrahydrofuran(76:22:2 v/v) **Fluorescence Detection:** λ_{ex} 250nm λ_{em}370nm **Linearity Range:** 0.25-100ng/ml **LOQ:** 0.25ng/ml	[14]
4	Enantioselective Determination	HPLC with fluorescence	**Stationary Phase:** Chiral stationary phase chiralpak AD 100 **Mobile Phase:** Hexane+2-Propranol(0.05%):Diethyl Amine 0.9% (65:35) **Detection :** λ_{ex} 238nm λ_{em} 370nm **Linearity Range: -**	[15]
5	Terazosin Tablet	HPLC with fluorescence	**Stationary Phase:** Shimpak column VP-ODS **Mobile Phase:** disodium hydrogen phosphate:acetonitrile:tetrahydrofuran(76:22:2)v/v **Detection: :** λex 250nm λem370nm **Linearity Range:** 20,180,320 ng/ml **LOD :** 0.1308ng/ml	[16]

6	Pharmacokinetic studies of Terazosin	HPLC-UV	**Stationary Phase:** RP C18 column **Mobile Phase:** Acetonitrile: THF: potassium dihydrogen phosphate(15:5:80) **Detection:** 254nm **Linearity Range:** 10-400ng/ml **LOQ:** 10ng/ml	[17]

1.4 Reported literature of Terazosin in combination with other drugs

Table 1.4 REPORTED LITERATURE OF TERAZOSIN IN COMBINATION WITH OTHER DRUGS.[18-20]

Sr No	Drug	Method	Description	Ref no
1	Terazosin+ Prazosin+ Doxazosin in Formulation	HPLC-UV	**Stationary Phase:** Kromacil c18 Column **Mobile Phase**: ACNdiethyle amine: Methanol: Ammonium acetate(60:20:20:0) **Linearity Range:** 2-500µg/ml **LOD:** 0.065 µg/ml **LOQ:** 0.197 µg/ml	[18]
2	Terazosin+ Alfuzosin +Prazosin+ Doxazosin+ Tamsulosin Formulation	HPLC-UV	**Stationary Phase:** c18 column **Mobile Phase:** ACNdiethylamaine: Methanol: ammonium acetate: water **Λ**: 230nm **Linearity Range:** 4-16 µg/ml **LOD:** 0.08 µg/ml **LOQ:** 0.264 µg/ml	[19]
3	Terazosin+ Prazosin in Formulation	HPLC-UV	**Stationary Phase:** Kromacil C18 Column **Mobile Phase:** Methanol **Flow Rate:** 1.1 ml/min **Linearity Range:** 10-60 µg/ml **LOD:** 0.514 µg/ml **LOQ:** 1.557 µg/ml	[20]

2. REVIEW LITERATURE OF TOLTERODINE TARTRATE.

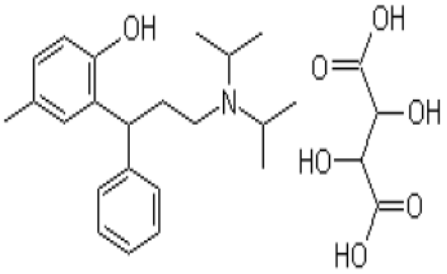

Fig 2.1: Chemical structure of Tolterodine tartrate.

Tolterodine is an antimuscarinic which is used to treat overactive bladder and to relieve urinary difficulties like frequent urination and inability to control urination. The chemical name of Tolterodine tartrate is (+)-(R)-2-[l-[2[(Diisopropylamino) ethyl] benzyl]-p-cresol L-tartrate (1:1) salt. It Works by at postganglionic muscarinic receptor, Tolterodine tartrate produce competitive antagonist effect for acetylcholine. Cholinergic muscarinic receptors are responsible for Urinary bladder contraction and salivation.

2.1 Official Method

TABLE 2.1: OFFICIAL METHODS OF TOLTERODINE TARTRATE[2]

Sr. No	Drug	Method	Description	Ref. No
1	Tolterodine Tartrate	Liquid Chromatography	**Stationary Phase:** Stainless still 25×4.6mm packed with octadecylsilane bonded with porous silica 5µm **Mobile Phase: A.**0.05M Potassium Dihydrogen orthophosphate pH 3.5 with Ortho phosphoric acid **B.** Acetonitrile Initial (65:35) **Method:** Gradient **Detection:** 215nm	[2]

2.2 Reported Chromatographic methods

TABLE 2.2 REPORTED CHROMATOGRAPHIC METHODS[21-33]

Sr No	Drug	Method	Description	Ref No
1	Tolterodine in bulk drug and Pharmaceutical dosage form	RP-HPLC	**Stationary Phase:** Hypersil c18 column **Mobile Phase:** Acetonitrile:10mM Ammonium acetate(80:20v/v) **Detection:** 283nm **Linearity Range:** 20-100µg/ml **Mean Recovery:** 99.39%	[21]
2	Tolterodine in Pharmaceutical dosage form	RP-HPLC	**Stationary Phase:** Hypersil BDS C18 Column. **Mobile Phase:** Potassium Phosphate pH 4.5:Acetonitrile(Mixed by low pressure gradient program) **Detection:**205nm **Linearity Range:**10-60 µg/ml **LOD:**0.6 µg/ml **LOQ:**10 µg/ml **Tailing Factor:** 1.00	[22]
3	Tolterodine Stability indicating Determination in Pharmaceutical dosage form	RP-HPLC	**Stationary Phase:** Reversed Phase C18 column. **Mobile Phase:** Buffer solution of ammonium dihydrogen phosphate: methanol (40:60) **Detection:** 220nm **Flow rate:** 1.5 mL/min. **Linearity Range:** 200.60-601.80 µg/ml **Retention time:** 6.49 min.	[23]
4	Tolterodine Tartrate in bulk and in Pharmaceutical dosage formulation.	RP-HPLC	**Stationary Phase:** Kromacil Symmetry C18 column. **Mobile Phase:** Phosphate buffer pH 3.0: Acetonitrile. **Detection:**282nm **Flow Rate:**0.8ml/min **Linearity Range:**20-100 µg/ml **% Recovery:** 98.1%-100.2% **LOD:** 0.108 µg/ml **LOQ:** 0.36 µg/ml	[24]
5	Tolterodine Tartrate in Capsule formation.	RP-HPLC	**Stationary Phase:** Reversed Phase C18 column. **Mobile Phase:** Methanol: phosphate buffer(40:60)v/v **Detection:** 220nm **Retention time:** 10 min.	[26]
6	Tolterodine tartrate in Tablet formulation.	HPLC	**Stationary Phase:** Kromacil C18 column. **Mobile Phase:** Acetonitrile:Methanol:Ammoniumacetatre pH3 (30:30:40) **Detection:** 281nm **Retention time:** 4.99 min. **Mean % Recovery:** 102.65% **Linearity Range:** 10-30 µg/ml	[27]
8	Tolterodine Tartrate stability indicating assay and impurities profiling.	RP-HPLC	**Stationary Phase:** C18 column **Mobile Phase:** Water: Acetonitrile **Detection:** 285 nm **Retention time:** 4.7 min	[25]
9	Tolterodine Tartrate	HPTLC	**Stationary Phase:** Aluminum plate precoated with silica gel G 60 **Mobile Phase:** Acetronitrile:Water:Formic acid(50:50:3) **Detection:** Densitometric absorbance mode at 281nm **Drug Found:** 99.1% **Linearity Range:** 10-30 µg/ml **LOD:**21ng **LOQ:**53ng	[28]
10	Tolterodine tartrate in tablet	HPLC	**Stationary Phase:** - **Mobile Phase:** Phosphate acetate 0.1M pH 2.5:acetonitrile: (50:50 v/v)	[29]

			Flow rate: 1.2 ml/min **Detection:** 285 nm **LOD:**5µg/ml **LOQ:** 10 µg/ml **Linearity Range:** 10-100 µg/ml	
11	Tolterodine Tartrate Stability indicating and assay method.	HPLC	**Stationary Phase:** Water X-Teraa MS C18 column. **Mobile Phase:** 0.05% TFA+ water: 0.05%+ Acetonitrile(Binary Gradient mode) **Detection:** 220nm **LOD:** 66ng/ml **LOQ:** 200ng/ml	[30]
12	Simultaneous estimation of Tolterodine and Tamsulosin in bulk and pharmaceutical dosage form.	RP-HPLC	**Stationary Phase:** Hypersil BDS **Mobile Phase:** Phosphate Buffer: Acetonitrile (65:35v/v) **Flow rate:** 1 ml/min **Detection:** 220nm **Retention time:** Tamsulosin: 2.285min Tolterodine: 4.334min **Linearity range:** Tamsulosin: 1-6 µg/ml Tolterodine 10-60 µg/ml	[31]
13	Simultaneous estimation of Tolterodine tartrate and Tamsulosin HCL assay method from combination capsule form.	HPTLC	**Stationary Phase:** Silica gel 60F254 **Mobile Phase:** methanol: ethyl acetate : triethylamine (5;5;0.3 v/v/v) **LOD:** Tamsulosin 13.26 ng/band Tolterodine 22.44ng/ml **LOQ:** Tamsulosin 44.34 ng/band Tolterodine 74.85 ng/band **Detection:** Densitometric signal at 220 nm	[32]
14	Simultaneous determination of Tartaric acid and Tolterodine in Tolterodine Tartrate.	HPLC	**Stationary Phase:** Acclaim Trinity P1 **Mobile Phase:** A: 5% 0.2 M NH4OAc,pH 4/ 52% water/ 43%CH3CN B: 80% 0.2 M NH4OAc ,pH 4/ 20% CH3CN **Flow rate:** 0.8 mL/min **Detection:** Corona *ultra* Charged Aerosol Detector	[33]

2.3 Summary of literature of spectrophotometric method for Tolterodine tartrate

TABLE 2.3 SUMMARY OF LITERATURE OF SPECTROSCOPIC METHOD FOR TOLTERODINE TARTRATE[37-44]

Sr No	Drug	Method	Description	Ref No
1	Tolterodine Tartrate in bulk and pharmaceutical formulation.	UV	**Solvent:** Water **Detection:** **Zero order :** 281.5nm **First order:** 274nm **AUC:** 276-286nm **Linearity Range:** 30-180 µg/ml	[37]
2	Tolterodine in bulk drug and formulation	Visible spectrophotometric	**Complex:** Charge Transfer colored complex of Tolterodine tartrate with N-Bromo succinimide, complexes with chloramines –T and Phosphomolybdic acid. **Detection:** 520nm,540nm,840nm **Linearity range:** 5-35ppm, 2-14ppm, 10-60ppm **LOD:** 0.03 µg/ml **LOQ:** 0.6 µg/ml	[38]
3	Tolterodine Tartrate in bulk and pharmaceutical dosage form.	UV spectrophotometric.	**Solvent:** 0.1N NAOH **Linearity Range:** 10-80 µg/ml **Detection:** 280nm **LOD:** 0.715 µg/ml **LOQ:** 2.167 µg/ml	[39]
4	Tolterodine Tartrate in bulk in pharmaceutical	Extractive colorimetric method using tropaeolin ooo-	**Solvent and Complex:** A Chloroform extractable orange red complex formed between the acid dye, tropaeolin OOO-1 and Tolterodine in acid media.	[40]

	dosage form.	1	**Detection:**503nm **Linearity Range:** 1-30 µg/ml **LOD:**0.08 µg/ml **LOQ:**1 µg/ml	
5	Tolterodine Tartrate in pure and Pharmaceutical forms.	Extractive visible method.	**Complex:** 1:1 ion pair complex of the drug with 3 acid dyes Bromophenolblue, bromocresol green, bromocresol purple dyes. **Detection:** 416,419,404nm **LOD:** 0.288,0.231,0.242 µg/ml	[41]
6	Tolterodine Tartrate in bulk and tablet dosage form.	UV Spectrophotometric.	**Detection:** 283nm **Linearity Range:** 10-50 µg/ml **LOD:** 0.1865 µg/ml **LOQ:** 0.5621 µg/ml	[42]
7	Tolterodine Tartrate in pure and formulations.	UV Spectro photometric.	**Detection:** 282nm **Linearity Range:** 60-120 µg/ml **% Recovery:** 99.93-100.37 **LOD:** 4.08 µg/ml **LOQ:**13.61 µg/ml	[43]
8	Tolterodine Tartrate in pure form and pharmaceutical preparation.	Spectro fluorimetric.	**Solvent:** Phosphate buffer pH 6 **Detection:** Native fluorescence in Methanol at 313nm After excitation at 285nm **LOD:** 0.090 µg/ml **LOQ:** 0.273 µg/ml	[44]

2.4 Summaries of other methods

TABLE 2.4 SUMMARIES OF OTHER METHODS [34-37]

Sr No	Drug	Method	Description	Ref No
1	Tolterodine and its metabolite in rat plasma and pharmacokinetic study.	LC-MS/MS method.	**Stationary Phase:** Ascentis Express RP amide column **Mobile phase:** 10mM ammonium acetate: Acetonitrile(20:80 v/v) **Flow rate:** 0.5mL/min **Linearity Range:** 20-5000pg/mL	**[35]**
2	Tolterodine Tartrate in human plasma and urine samples.	UPLC Assay method.	**Detection:** 220nm **Stationary Phase:** BEH C18 Sub-2- µm **Mobile Phase:** Trifluroacetic acid: Acetonitrile **LOD:** 0,05 µg/ml **LOQ:** 0.15 µg/ml **Retention time:** 2.4min	**[36]**
3	Tolterodine Tartrate and its metabolite in human plasma and pharmacokinetic study.	UHPLC-ESI-MS/MS	**Mobile Phase:** Ethyl acetate: n-hexane(70:30v/v) **Stationary Phase:** Agilent Zorbax XDB-phenyl comumn. **Detection:** Electro spray ionization **LOQ:** 5.0pg/ml	**[34]**

CONCLUSION

This review depicts the reported Spectrophotometric and Chromatographic methods; developed and validated for estimation of Terazosin Hydrochloride and Tolterodine tartrate. According to this review it was concluded that for Terazosin Hydrochloride and Tolterodine Tartrate different Spectroscopic & Chromatographic methods are available for Single component as well as for combination and also it was found that the Mobile phase containing Phosphate buffer, Methanol and Acetonitrile were common for most of the chromatographic method to provide more resolution. For Chromatographic method flow rate was observed in the range of 0.8-1.5 ml/min to get good retention time. For most of the Spectroscopic methods common solvent was Methanol. This all methods were found to be simple, accurate, economic, precise and reproducible in nature.

Financial support and sponsorship: nil.

ACKNOWLEDGEMENT

The authors are thankful to DR. K.Pundarikakshudu, Director of L.J. Institute of Pharmacy, Ahmedabad, India for providing all the facilities and encouragement to carry out work.

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