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A Review of Analytical Methods for Losartan Potassium Estimation in Pharmaceutical Preparation

A. Raja Reddy[1*], K. Sunitha[2], N.Divya[3], R.Kiran[4]

[1]*Associate Professor, Department of Pharmaceutical Analysis, CMR College of Pharmacy, Hyderabad, Telangana, India*
[2]*Associate Professor, SSJ College of Pharmacy, Hyderabad, Telangana, India*
[3]*PG student, Department of Pharmaceutical Analysis, CMR College of Pharmacy, Hyderabad, Telangana, India*
[4]*Assistant Professor Department of Pharmaceutical Analysis, CMR College of Pharmacy, Hyderabad, Telangana, India*

***Address for correspondence: Aleti Raja Reddy**
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ABSTRACT

Angiotensin II receptor blockers, the first novel type of antihypertensive medication, includes losartan potassium. High blood pressure, commonly known as hypertension, is a disorder that develops when the blood pressure is too high. The smaller blood arteries (the arterioles) constrict, which causes increased blood pressure against the artery walls and makes the heart work harder to maintain blood pressure. This condition is known as hypertension. The tablet-based medication has been marketed as "the antihypertensive for the '90s and beyond" with a reduced incidence of adverse effects than (is) typically associated with other antihypertensives. The analytical methods Based on previously published articles from a variety of journals, this study includes UV spectroscopy, Reverse phase-high performance liquid chromatography (RP-HPLC), High performance thin layer chromatography (HPTLC), Liquid chromatography/mass spectrometry (LC/MS), and Ultra performance liquid chromatography mass spectrometry(UPLCMS).

Keywords: Losartan potassium, UV, HPLC, hypertension.

INTRODUCTION[1]

Angiotensin receptor type AT1 antagonist losartan potassium. The chemical name for losartan is 2-butyl-4-chloro-1-[p-(o-1H-tetrazol-5- yl phenyl)benzyl]imidazole-5-methanol monopotassium salt. It is a non-peptide molecule. C22H22ClKN6 is the empirical formula for it. With a molecular weight of 461.01, losartan is a free-flowing, crystalline powder that is white to off-white in color. It dissolves readily in water, is soluble in alcohols, and dissolves just marginally in typical organic solvents like acetonitrile and methyl ethyl ketone. The active metabolite of losartan is produced by the 5-hydroxymethyl group on the imidazole ring being oxidized. The way losartan works is

Angiotensin II is a powerful vasoconstrictor, the main vasoactive hormone of the renin-angiotensin system, and a key player in the pathophysiology of hypertension. It is produced from angiotensin I in a mechanism catalyzed by the enzyme angiotensin converting enzyme (ACE, kininase II). Moreover, it encourages the adrenal cortex release of aldosterone. Angiotensin II's vasoconstrictor and aldosterone-secreting activities are inhibited by losartan and its main active metabolite by specifically preventing angiotensin II from binding to the AT1 receptor, which is present in numerous tissues (e.g., vascular smooth muscle, adrenal gland). The AT2 receptor is also present in numerous organs, however it is unknown if it affects cardiovascular homeostasis. Losartan and its main active metabolite both

have a substantially stronger affinity for the AT1 receptor than the AT2 receptor and neither show any partial agonist action at the AT1 receptor. It has an oral bioavailability of about 33%, is easily absorbed from the gastrointestinal tract, and about 14% of a losartan dose is converted to a pharmacologically active metabolite. The volumes of distribution of losartan and its active metabolite are 34 and 12 liters, respectively, and the plasma elimination half-life is between 1.5 and 2.5 hours.

Side effects are Headache, Irregular heartbeat, Chest pain, weakness, Cold, Dizziness, Backpain.

Trade name:- COZZAR

Dose:- 25 mg, 50 mg and 100 mg

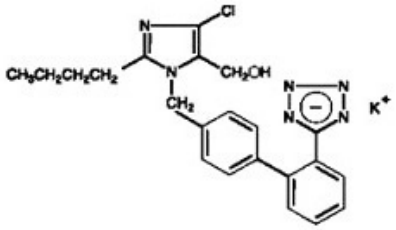

Fig. 1: Losartan molecular structure

Table 1: Review of Literature

S.No.	AUTHOR NAME	JOURNAL NAME	TITLE NAME	ANALYTICAL CONDITIONS
01	Olga C.Lastra, Igor G.Lemus, Hugo J.Sachez Renato F.Perez [2]	Journal of Pharmaceutical and Biomedical Analysis,2003	Development and Validation of an UV derivative Spectrophotometric determination of Losartan potassium in tablets	Solvent-NaOH, water λmax -234nm Linearity-4.00-6.00mgl^{-1} Correlation coefficient-0.9938
02	Permender Rathee Sushila Rathee, Hema Chaudharya & Dharmender Rathee [3]	Journal of Pharmacy Research,2008	Devlopment & Validation of a Stability indicating UV Spectrophotometric method for the Estimation of Losartan potassium in bulk & tablet dosage form	Solvent-0.01 N HCl λmax -227.4nm Linearity-2.02-22.22 mg/ml %RSD 0.303-0.334 Accuracy-98.11-99.85% LOD- 0.156µg/ml LOQ- 0.472µg/ml
03	Priyanka R. Patil, Sachin U Rakesh, PN Dhabale & KB Burade[4]	Asian Journal of Research Chem. 2009	Simultaneous Uv Spectrophotometric method for Estimation of Losartan potassium and Amlodipine besylate in tablet dosage form	Solvent-Methanol λmax - 208 nm and 237.5 nm Iso absorptive point 242.5 nm Linearity-2-20µg/mL. %Recovery- 99.95%-102.93%,99.33%- 101.02%
04	Sanjay Bari,Shital Sathe, Pritam Jain, and Sanjay Surana[5]	Journal of Pharm Bioallied Sci.2010 Oct-Dec	Spectrophotometric method for Simultaneous Estimation of Atenolol in combination with Losartan potassium & Hydrochlorothiazide in bulk and tablet formulation	Solvent-Methanol, water λmax-251.60nm,224.20nm, 271.60nm Linearity-5-30µg/ml,2-12µg/ml, 2-14µg/ml Correlation coefficient-0.9991,0.9995,0.9993
05	K.Srinivas Rao, Panda M, Keshar NK[6]	Chronicles of Young Scientists 2011	Spectrophotometric methods for the Simultaneous Estimation of Losartan potassium and Hydrochlorothiazide in tablet dosage forms	Solvent-Methanol, distilled water λmax-266.5nm LSP Linearity- 5–25 µg/ml 5-80µg/ml %RSD- 99.06±1.210 HZ Linearity-1–20µg/ml 1-25µg/ml %RSD-99.30±1.159
06	Rao Plkm, Venugopal V, Anil Kumar G, Rajesh B, Prasad Gal Ravinder Goud D[7]	International Journal of Research in Pharmacy & Chemistry, 2011	Quantitative Estimation of Losartan Potassium in Pharmaceutical Dosage forms by UV Spectrophotometry	Solvent-Methanol, distilled water λmax -234nm Linearity-8-22µg/ml LOD-9.7µg/ml LOQ-29.74µg/ml Correlation coefficient-0.9989

07	Ramya Gavini, S.B.Puranik, G.V.S.Kumar, K.A.Sridhar[8]	Archives of Applied Science Research, 2012, ISSN 0975-508	Simultaneous Estimation of Amlodipine & Losartan by UV-Method in Bulk drug & Tablet dosage formulation	Solvent-Methanol λ-max- 237nm,202nm Linearity-1.25-7.5µg/mL, 12.5-75µg/mL LOD-0.02µg/ml,0.03µg/ml LOQ-0.03µg/ml,0.05µg/ml Correlation coefficient-0.998,0.999 %Recovery-97.3-102.3%
08	Dobrina D. Tsvetkova,danka P. Obreshkova[9]	International Journal of Pharmacy and Pharmaceutical Sciences, 2012	Validation of UV-Spectrophotometric method for Identification and Determination of Angiotensin Ii Receptor Antagonist Losartan potassium	Solvent-Distilled water λmax-208nm LOD-$3.1.10^{-8}$µg/ml LOQ-$1.04.10^{-7}$µg/ml Correlation coefficient-0.9713
09	A.Gajbhiye and N. Dwivedi[10]	Current Trends in Technology and Science,2012	Simultaneous Estimation of Losartan and Atenolol by UV Spectrophotometric method	Solvent-Water: Methanol (80:20) Linearity- 5-50µg/mL λmax -232nm,275nm LOD-0.380µg/mL,0.860 µg/mL LOQ-1.16µg/mL,2.6 µg/mL %RSD-0.0060, 0.0200
10	Babu Lal Saini, Pramod Kumar, Ravi Dahiya, Javed Akhtar, Birendra Shrivastav[11]	Research Journal of Pharmacy & Technology,2013	Development and validation of a UV-Spectrophotometric method for Simultaneous Estimation of Hydrochlorothiazide and Losartan potassium in Bulk drug and its Formulations	Solvent- 0.01M Sodium Hydroxide λmax -274nm,234nm Linearity-5-20µg /ml, 1-10 µg/ml LOD-0.1059µg/ml,0.0389µg/ml LOQ-0.321µg/ml,0.118µg/ml Recovery studies- 102.29-103.10%, 99.52-101.60% % RSD less than 2
11	Syed S ul Hassan,Syeds FA Zaidi,Imran Tariq and Muhammad T Ansari[12]	Tropical Journal of Pharmaceutical Research,2013	Development and Validation of Analytical method for Losartan-Copper Complex using UV-VIS Spectrophotometry	Solvent-Glacial acetic acid, water λmax -530nm Linearity-10-50µg/ml %RSD-0.97%,0.82% Correlation coefficient-0.9989
12	Chaitali Thube, Jyoti Dhagude and P.Y.Pawar[13]	Der PharmaChemica, 2014	Simultaneous Estimation and Validation of Losartan potassium and Hydrochlorothiazide in Bulk and Tablet dosage form by using different Spectrophotometric method	Solvent-Methanol λmax -235nm,271nm Linearity-5-30µg/ml %Recovery-98-102%
13	Manisha Masih, Abhilasha Mittal, Nandy Bc[14]	Asian Journal of Pharmaceutical & Clinical Research, ISSN - 0974-244	Spectrophotometric Simultaneous estimation of Amlodipine Besylate & Losartan potassium in Tablet dosage forms	Solvent- Methanol:1 N HCl (1:1) λmax -240 nm,220nm Linearity- 2-30µg/ml Correlation coefficient-0.9985, 0.9986
14	Amna B. W. E. Mohammed and Elsadig H. Rudwan[15]	Der Pharma Chemica, 2015	Development and Validation of an UV derivative Spectrophotometric determination of Losartan potassium in Tablet	Solvent-Methanol λmax -234 nm Linearity-4-14µg/ml Correlation coefficient-0.9996
15	Nalanda T. Rangari1, Prashant K. Puranik, Sanjay R. Chaudhari[16]	International Journal of PharmTech Research,2015	Spectrophotometric determination of Losartan potassium in pure form and in tablet dosage form	Solvent-Distilled water λmax -232nm Linearity-2-12µg/ml Correlation coefficient- 0.9998 LOD- 0.0412µg/ml LOQ- 0.1371µg/m

16	Maneesha.Narisetty, A. Elphine Prabahar, P.V.Suresh, RamaRao.N[17]	Journal of Pharmacy and Biological Sciences	Simultaneous Estimation of Hydrochlorothiazide & Losartan potassium in Bulk Solid dosage form by Chemometric Assisted Spectrophotometric methods	Solvent-Alcohol λmax -271nm,213nm Linearity-1-5µg/ml, 2-10µg/ml Correlation coefficient-0.945,0.964 %Recovery- 85-105% %RSD-<2
17	Dobrina Doncheva Tsvetkoa,Stefka Achkoa Ivanova[18]	Indo American Journal of Pharmaceutical Sciences,2018	Application of UV-Spectrophotometric method for determination of Losartan potassium in tablets	Solvent-Distilled water λmax -208nm Linearity-$3.5.10^{-8}$-1.10^{-7} Correlation coefficient-0.9713 LOD=$3.1.10^{-8}$ LOQ=$1.04.10^{-7}$
18	Rimpalben patel,Jignesh Shah,Dilip G.Maheshwari[19]	Journal of Global Trends in Pharmaceutical Sciences	Development and Validation of Q- Absorbance ratio Spectrophotometric method for Simultaneous method for Simultaneous Estimation of Aliskiren & Losartan potassium in Synthetic mixture	Solvent-Distilled water λmax -272nm,250nm Linearity-15-90µg/ml,5-30µg/ml LOD-0.082µg/ml,0.280µg/ml LOQ-0.250µg/ml,0.850µg/ml Correlation coefficient-0.993,0.9986
19	Avinash V. Chavan, Dr. Ansar M. Patel, Vandana T. Narvekar, Arati R. Kapase, Shreya Gaikwad[20]	World Journal of Pharmacy and Pharmaceutical Sciences,2019	Development & Validation of Spectrophotometric methods for the Estimation of Atenolol & Losartan potassium in Bulk and Tablet dosage form	Solvents-Ethanol& distilled water Correlation coefficient-0.974 to 0.989 AT Λmax-275 nm & 253 nm LOD-0.198µg/ml & 1.155µg/ml LOQ- 0.6µg/ml and 3.5µg/ml LSP Λmax-235nm & 242nm LOD-0.132µg/ml, 0.143µg/ml LOQ- 0.4µg/ml & 0.43µg/ml
20	Hasna Ahmed Abdelhadi and Abdalla Ahmed Elbashir[21]	Journal of Pharmacy and Drug Development,2020	Spectrophotometric method development and validation for the determination of Losartan potassium in Pharmaceutical Formulation using Hydroxypropyl-β-cyclodextrin	Solvent-Double distilled water λmax -205nm Linearity-1.010mgL^{-1} LOD-0.327µgml^{-1} LOQ-0.4022µg/ml^{-1} %RSD-0.2507 Correlation coefficient-0.9997
21	Priyanka R. Patil, Sachin U. Rakesh, P.N. Dhabale, Prof. K. B.Burade[22]	International Journal of ChemTech Research,2009	RP-HPLC Method for Simultaneous Estimation of Losartan potassium and Amlodipine Besylate in Tablet Formulation	Column- RP C-18 (Microsorb-MV 100-5, 250 x 4.6 mm) Mobile phase- 0.02% triethylamine in water: acetonitrile (60:40) λmax -226 nm Linearity-50-500µg/mL,5-50µg/mL Flow rate -1.0 ml/min Retention time- 2.32 &10.10 min
22	K. Srinivasa Rao&K. Srinivas[23]	Indian Journal of Pharmaceutical Science, 2010	RP-HPLC Method for the determination of Losartan potassium & Ramipril in Combined Dosage form	Column- Hypersil ODS C18, 4.6×250 mm, 5µm Mobile phase-Acetonitrile: Methanol l:10 mM tetra butyl ammonium hydrogen sulphate in water (30:30:40% v/v/v) Flow rate-1.0 ml/min λmax -210 nm Linearity-0.04-100µg/ml,0.2-300µg/ml RetentionTime-4.7min,3.3min

23	S.Jayaseelan, M. Rajasekar, S.Ganesh, V. Sekar, P. Perumal[24]	Der pharma Chemica, 2010	Development and Validation for Simultaneous Estimation of Losartan potassium, Amlodipine besylate and Hydrochlorothiazide in tablet dosage form	Column- C18 reverse-phase column (250 X 4.6 mm I.D., particle size 5µm) Mobile phase-phosphate buffer (pH 7.0), methanol and acetonitrile in ratio of 60:20:20% v/v λmax -238nm Linearity-200.24-300.36 µg/mL, 27.84-41.76µg/mL, 50.00-75.00µg/mL %Recovery-100.15%
24	Abdussaleem.K,D.Boopathy,P.Perumal[25]	International Journal of Pharmatech Research,2010	Analytical Method development and Validation of Losartan potassium and Atenolol in Combined dosage form by RP-HPLC	Column-C18 column (Phenomenex C18, 5µ,250mm x 4.6mm) Mobile phase-Triethylamine: Acetonitrile: Methanol in the ratio of 50:30:20 λmax -235nm Linearity-80-120µg/mL Retention time- 3.767 min,2.210min %Recovery- 98%,102%
25	A.B. Thomas, U.B Chavan, R.K Nanda, L.P. Kothapalli, S.N. Jagdale, S.B. Dighe, A.D. Deshpande[26]	Acta Chromatographica, 2010	Simultaneous RP-HPLC Analysis of Atenolol, Hydrochlorothiazide and Losartan potassium in a Tablet formulation Simultaneous RP-HPLC	Column-C18 column Mobile phase- 0.035 M potassium dihydrogen orthophosphate acetonitrile gradient λmax -225nm Linearity-5-50µg/mL^{-1},0.5-30µg/mL^{-1},1-60µg/mL^{-1} Retention time-2.91, 4.75, and 7.52 min Recovery-99.67,99.89,100.69%
26	J. Kavitha, S. Muralidharan[27]	International Journal of ChemTech Research,2010	Development and Validation of new method for Atenolol, Hydrochlorothiazide and Losartan potassium by RP-HPLC: Its Application to Routine Quality Control Analysis	Column-Phenomenex C18 column Mobile phase- acetonitrile: 50mM potassium dihydrogen ortho phosphate (pH 3.5) ratio 50:50 λmax -270nm Linearity-10-60µg/mL,2.5-15µg/mL,5-60µg/mL Retention time-5.550, 3.280, 7.370 & 12.397
27	Md. Arif Hossen, Md. Ahsanul Haque, Irin Dewan, A.N.M. Hamidul Kabir, Md. Khalid Hossain & S.M. Ashraful Islam[28]	Dhaka University Journal of Pharmaceutical Sciences, 2011	Development and Validation of RP-HPLC Method for the Simultaneous Estimation of Hydrochlorothiazide and Losartan potassium in Tablet dosage form	Column-CLC-ODS column (250 mm X 4.6 mm, 5µ Mobile phase- 0.025 M phosphoric acid solution: acetonitrile (60:40 v/v, pH 3.0 adjusted with 80% phosphoric acid) λmax -254nm Retention time -3.748min and 8.790min Recovery-100.16%,100.4%
28	Dubey R, Bhusari VK, Dhaneshwar SR[29]	Scientia Pharmaceutica. 2011	Validated RP-HPLC Method for Simultaneous Quantitation of Losartan potassium and Metolazone in Bulk drug & Formulation	Column- Thermo Hypersil BDS–C18 (250 mm × 4.6 mm, 5.0 µm) Mobile phase-Acetonitrile: water (60:40) λmax -237nm Linearity-2–12µg/mL, 0.2–1.2µg/mL Flow rate-0.8 mL/min

29	Muralidharan Selvadurai, Subramaniya and Nainar Meyyanathan[30]	Pharmaceutical methods,2011	Sensitive and Accurate Estimation of Losartan potassium formulation by High- Performance Thin-Layer Chromatography	Column-Aluminum-backed silica gel $60F_{254}$ Mobile phase-Acetonitrile: Methanol:0.1%Acetic acid (3.5:2.6:3.9 v/v) λmax -270nm Linearity-5-50µg/ml LOD-1.190µg/ml LOQ-3.608µg/ml Correlation coefficient-0.9997
30	M Sumithra, P Shanmugasundaram, ASK Sankar, Niharika[31]	Research Journal of Pharmaceutical, Biological and Chemical Sciences, 2012	Method development and Validation of Losartan potassium by RP-HPLC	Column-Hypersil Silica (250 x 4.6 mm Mobile phase-Acetonitrile: Triethylamine buffer ph_3 (50:50) λmax -254nm Linearity-40-120µg/ml Retention time- 5.1min Flow rate- 1.0ml/ min
31	Ramya Gavini, S.B. Puranik, G.V.S. Kumar, K.A. Sridha[32]	International Research Journal of Pharmacy, 2012	Development and Validation of Stability Indicating RP-HPLC method for Simultaneous Estimation of Amlodipine & Losartan in Bulk drug and Tablet dosage formulation	Column-C18 G (250mm x 4.6mm, 5µm) Mobile phase- 0.005M Potassium dihydrogen phosphate: Acetonitrile (pH 3.0) (50:50v/v) λmax -230nm Linearity- 0.125-0.75µg/mL, 1.25-7.5µg/mL
32	Neela M. Bhatia, Sachin B. Gurav, Swapnil D. Jadhav & Manish S. Bhatia[33]	Journal of Liquid Chromatography & Related Technologies,2012	RP-HPLC Method for Simultaneous Estimation of Atorvastatin calcium, Losartan potassium, Atenolol and Aspirin Tablet dosage form and Plasma	Column-KYA TECH HiQ Sil C18HS (250 × 4.6 mm i.d.,5 µm particle size) Mobile phase- Acetonitrile: 0.02M potassium dihydrogen phosphate buffer (pH 3.4) λmax -236nm Linearity- 25–150, 50–300, 100–600, and 50–300ng/mL
33	Bhaumik C Patel[34]	Chemistry Indo American Journal of Pharmaceutical Research,2013	Method development and Validation for Simultaneous Estimation of Enalapril Maleate and Losartan potassium in Bulk and Pharmaceutical dosage form	Column-Hyperchrom phase C-18 BDS Hypersil column (250mm × 4.6 mm id 5µm) Mobile phase- Buffer-Acetonitrile (60:40 v/v) λmax -236nm Linearity- 5-15µg/ml, 25-75µg/ml % Recoveries- 98.47% - 100.68% and 98.49% -100.61% LOD- 0.120µg/ml,0.606µg/ml LOQ- 0.365µg/ml,1.839µg/ml
34	Jagadeeswara rao V, Vasanth Pm, Ramesh T, Ramesh M[35]	International Journal of Chemtech Research,2013	Analytical method development and Validation of Losartan potassium & Hydrochlorothiazide in Combined dosage form by RP-HPLC	Column-C18 column (Agilent XDB C18, 150 x 4.6 mm, 5µm) Mobile phase- Buffer: Acetonitrile 65:35%v/v λmax -254nm Linearity- 25-75µg/ml, 6.25-18.75µg/ml LOD-1.779 ug/ml,0.375µg/ml LOQ-5.393 and 1.138 µg/ml
35	Tengli AR, Gurupadayya BM[36]	Journal of Chromatography Separation Techniques,2013	Method development and Validation of tablet dosage form containing Losartan, Atenolol & Hydrochlorothiazide using Internal standard by RP-HPLC	Column-Phenomenex luna 5 µ CN 100R, 250×4.60 mm 5µm Mobile phase- Acetonitrile and 0.2% of Diammonium hydrogen orthophosphate buffer λmax -230nm

				Linearity- 25-150 μgmL^{-1}, and 6.25-37.50 μgmL^{-1}
36	Savita S Yadav, Janhavi R. Rao[37]	International Journal of Pharmacy & Pharmaceutical Sciences 2014	Simultaneous Estimation of Losartan, Hydrochlorothiazide and Atenolol from Solid dosage form by RP-HPLC	Column-Hypersil Gold Column(250mm,4.6mm,5µ) Mobile phase-Acetonitrile: pot. Dihydrogen phosphate buffer 40:60 λmax -217nm Linearity-25-150µg/ml, 1-6 µg/ml Retention time- 5.87min and 3.61min Correlation coefficient-0.999
37	R. Vijayalakshmi, P. Sandya, M. Poorna Chandra Rao, M.D. Dhanaraju[38]	International Journal of Pharmaceutical Sciences and Drug Research,2014	RP-HPLC Method for Simultaneous Estimation of Perindopril and Losartan in pure form and tablet formulations	Column-LUNA C18 column Mobile phase- Methanol and phosphate buffer (pH 6.8) λmax -210nm Linearity-200-500 &30-80 µg/mL Flow rate-0.8 ml/min
38	Ganipisetty, L.A. Dachinamoorthy, D.Rao, J.V.L.N[39]	International Journal for Pharmaceutical Research Scholars,2014	A Sensitive RP-HPLC Method development and Validation for the Simultaneous Estimation of Losartan potassium & Hydrochlorothiazide	Column-Intersil ODS -3V Column (150 × 4.6 mm i.e., 5µm Mobile phase- Acetonitrile and phosphate buffer λmax -226nm Linearity-20–150µg/mL and 5-40µg/mL
39	Harshal A. Pawar,K. G. Lalitha[40]	Chromatography Research International,2014	Development and Validation of a Novel RP-HPLC Method for Estimation of Losartan potassium in Dissolution Samples of Immediate and Sustained Release tablet	Column-Zorbax Eclipse XDB C_{18} column (150 mm × 4.6 mm, 5µm) Mobile phase- orthophosphoric acid (0.1% v/v)acetonitrile (55 : 45, v/v) λmax -225nm Flow rate- 1.0 mL/min.
40	Naveen Babu Kilaru, Murali Krishna Javvaji, Rajani, Kumar Valluru, Krishna Mohan Chinnala[41]	International Journal of Pharmacy and Biological Science,2015	Development and Validation of RP-HPLC Method for Estimation of Losartan potassium in pharmaceutical dosage form	Column-Hypersil ODS C18, 4.6×150 mm, 5µm Mobile phase- Triethylamine solution (0.5%) pH 2.4 and acetonitrile 65:35 (v/v) λmax -225nm Linearity-0.05-100µg/ml %Recovery-100.1 and 101.2.
41	Aneesh T.P, Renju Radhakrishnan, Aravind P.M, Anuja Sasidharan, Manisha Choyal[42]	International Research Journal of Pharmacy,2015	RP-HPLC Method for Simultaneous determination of Losartan and Chlorthalidone in Pharmaceutical dosage form	Column-Phenomenex C18 column. Mobile phase- Acetonitrile: Water (80:20v/v) λmax -284nm Linearity-20-100µg/ml Retention time-1.72 min &2.64 min Flow rate-1.0 ml/minute
42	Mayur S. Malunjkar, N.B. Mahale, A.D. Landge, S.R. Chaudhari[43]	International Journal of Pharma Sciences and Research, 2015	Stability Indicating RP-HPLC Method development and Validation for Simultaneous Estimation of Atenolol, Losartan potassium and their degradation products	Column-RP C18 (Thermo), 250×4.60 mm 5-micron size Mobile phase- Methanol, 0.1% ortho-phosphoric acid (65:35v/v) λmax -274nm Linearity-10-50µg/ml
43	P. Haritha, B. Sreenivasa Rao, Y. Sunandamma[44]	International Journal of Chemical Sciences, 2016	Stability Indicating RP-HPLC Method for Simultaneous Estimation of Hydrochlorothiazide, Amlodipine besylate &	Column-Phenomenex ODS 2, C18 (150 mm × 4.6 mm, 5 µm) Mobile phase-Methanol and 0.1% (v/v) orthophosphoric acid 65:35 v/v λmax -254nm

			Losartan potassium in bulk and tablet dosage form	Linearity- 5.12 to 49.60µg/mL, 2.52 to 25.24µg/mL, 10.02 to 250.44µg/mL Retention time-2.30, 3.52 and 5.09 min
44	Mr. Sagar M. Bhangale, Mr. Vitthal S. Hiwale, Mr. Sachin, S. Rane, Dr .Rajesh, Y. Chaudhari,Dr. Vijay R. Patil[45]	International Journal of Pharmaceutics & Drug Analysis, 2016	Development and Validation of RP-HPLC Method for the Simultaneous Estimation of Atenolol, Losartan potassium & Hydrochlorothiazide in Tablet formulation	Column-RP-Purosnosphere C18 column (5 µm, 4.6mm×250 mm) Mobile phase- Methanol: water (77:23, v/v) Λmax-230nm Linearity- 20-120 µg/ml, 5-30 µg/ml Correlation coefficient-0.9999, 0.9998, 0.9990 Flow rate-1.1 mL/min
45	M.A. Hinge, V.M. Bhanusali & Rajvi J. Mahida[46]	Analytical Chemistry Letters, 2016	Spectrophotometric and High-Performance Liquid Chromatographic determination of Chlorthalidone and Losartan potassium in combined dosage form	Column-C18 **(**250 mm × 4.6 mm, 5µm) Mobile phase- Acetonitrile: Water (50: 50, v/v) λmax -249nm and 237nm Linearity- 10-30µg/mL, 20-60 µg/mL Correlation coefficient-0.9996 & 0.9988
46	Ramesh Sawant, Kalyani Jadhav, Ajay Shirsat[47]	Analytical Chemistry and Indian Journal,2016	Development and Validation of RP-HPLC method for Simultaneous Estimation of Losartan potassium and Amlodipine besylate in Synthetic mixture and pharmaceutical dosage form	Column-HibarR 250-4.6 PurospherR STAR RP-C18 (5µm) Mobile phase-0.1% triethylamine in water: methanol (32:68 v/v) λmax -235nm Flow rate-1.0 ml/min Linearity-5-50µg/mL Retention time-7.650 and 6.417 LOD-0.04µg/mL,0.0019µg/mL LOQ-0.10µg/mL,0.0027µg/mL
47	Latif A, Akbar F, Khan AJ, Shafi H, Mazhar M[48]	Pharmaceutica Analytica Acta,2018	Development and Validation of Analytical method for Quantification of Losartan potassium in Solid dosage form	Column-Octadecyl silyl (C18) column (15 cm x 4.6 mm x 5 µl) Mobile phase- 0.01M monobasic potassium dihydrogen phosphate buffer: methanol (40: 60), λmax -230nm Linearity-1-3 µgmL-1 LOD- 0.036 µgmL-1 LOQ- 0.110 µg/ml %RSD- 1.823%
48	Amit Kumar Jain,B.K. Dubey, Amit Joshi, Salaj Khare, Rajesh Bhardwaj, Prabhat Jain[49]	Asian Journal of Pharmaceutical Education and Research,2018	Validated RP-HPLC Method development for the Estimation of Losartan potassium in Marketed Formulation	Column-Thermo C_{18} column (4.6 x 250mm, 5µ particle size) Mobile phase- Methanol: Acetonitrile (10:90v/v) λmax -286nm Linearity- 5-25µg/ml %Recovery- 100.22%
49	Nalini Kanta Sahoo, N.Sreeja[50]	Advanced Research Chemistry & Applied Science,2019	RP-HPLC method development & Validation for Simultaneous Estimation of Losartan potassium and Amlodipine besylate in bulk and marketed formulation	Column-C18 (150 × 4.6 mm I.D) 3.5 µm Mobile phase-Acetonitrile: Phosphate Buffer pH 6 in the ratio of 50:50 λmax -230nm Linearity- 40 µg/mL to 140 µg/mL,4 µg/mL to 14 µg/mL LOD- 0.09 µg/mL, 0.07 µg/mL LOQ- 0.27 µg/mL, 0.23 µg/mL

				%Recovery-100.86 and 99.81
50	Nidhal M. Sher Mohammed, R. Abdo & Hassan M[51]	International Journal of Pharmaceutical Science & Research,2019	Method development and Validation of Simultaneous determination of Hydrochlorothiazide and Losartan in tablet dosage form by RP-HPLC	Column-ACE3-C18(250mm, 4.6mm, Ultra-pure silica) Mobile phase-40% ACN λmax -226nm Linearity-2-10 and 5-50µg/ml LOD-0.5µg/mL LOQ-1.5µg/mL %Recovery-92 and 96%
51	Ramya Sri Badugu, Elphine Prabahar A, Rama Rao Nadendla[52]	Journal of Pharmaceutical Science & Research, 2020	Analytical method development and Validation for the Simultaneous Quantization of Metolazone & Losartan potassium in Bulk drug and in pharmaceutical dosage form by RP-HPLC	Column-Agilent TC-C18 4.6 x250mm 5µm Mobile phase-pH 2.85 phosphate buffer (0.02M) and methanol (35:65) v/v λmax -230nm Linearity -1µg/mL to 5µg/mL and 10µg/mL to 50µg/mL Correlation coefficient-0.995,0.996 %RSD-<2%
52	M.M. Eswarudu, P. Sakheena, K. Lahari, P. Srinivasa Babu, M. Chinna Eswaraiah[53]	Asian Journal of Pharmaceutical Research and Development,2021	Validated RP-HPLC Method for Simultaneous Estimation of Atenolol, Hydrochlorothiazide & Losartan potassium in Bulk and pharmaceutical dosage form	Column-Hypersil C18, 250 ×4.6mm, 5µm Mobile phase- Acetonitrile and Potassium dihydrogen ortho phosphate buffer 40:60 (V/V) λmax -225nm Linearity- 50-150µg/mL,12.5-37.50µg/mL, and 50- 150µg/mL Retention time-1.46, 2.21 and 3.30 min %Recovery-97.56 %, 97.72 % and 98.06 %
53	S.V.S.G.B.Prasad, Savithri Shivakumar, T. Sudhir, R. Mital, G. Devala rao[54]	International Journal of Pharmacy and Pharmaceutical Sciences,2009	LC/MS/MS Method for the Simultaneous Estimation of Losartan potassium and Irbesartan in Rat plasma	Column-RP 80A 4µColumn Mobile Phase-Methanol:0.1%Formic acid Linearity-5.01-1000.8ng/ml Injection volume-10µL Retention time - 2.68min, 2.75min
54	Wankhede SB, Raka KC, Wadkar and Chitlange SS[55]	Journal of Pharmaceutical Research,2010	Development and Validation of Stability Indicating HPTLC Method for Analysis of Amlodipine besylate, Losartan potassium & Hydrochlorothiazide in Pharmaceutical dosage form	Column-Aluminum precoated with silica gel 60F Mobile phase - Chloroform:Ethylacetate:Methanol:Ammonia(4:4:2:0.2v/v/v/v) λmax -232nm Linearity-100-800ng/band,400-2400ng/band,1000-8000ng/band LOD-40.26,5.20,6.42ng/spot LOQ-121.9,15.7,19.4ng/spot
55	Nikita D. Patel, Anandkumari D. Captain, Kreny E. Parmar[56]	International Journal of Pharmacy & Pharmaceutical Sciences,2013	Development and Validation of HPTLC Method for Simultaneous determination of Atenolol and Losartan potassium in Bulk and in pharmaceutical dosage form	Column-Precoated silica gel 60F254 plates Mobile phase-Methanol: Ethyl acetate: Toluene: Triethylamine (4:3.9:2:0.1 v/v/v/v) λmax -226nm Linearity-400-1400ng/spot LOD-22.45,11.02ng/spot LOQ-68.04,33.4ng/spot
56	Anandakumar karunakaran,Jayamariappan Muthuvijayan,Ramu Chinthala,Vetsa subhash[57]	Journal of Pharmaceutical Chemistry,2014	Development and Validation of Analytical methods for the Simultaneous Estimation of Losartan potassium &	Mobile phase-Acetnitrile:0.1%Trifluoroacetic acid(40:60%v/v) Chloroform: Methanol 10:1%vv

			Metolazone in Bulk & in pharmaceutical dosage form by RP-HPLC and HPTLC	λmax -230nm,236nm Flow rate- 0.8mL/min R_f -0.18,0.42
57	Anandkumar R. Tengli, G.Shivakuma, B.M. Gurupadayya[58]	American Journal of Analytical Chemistry,2015	UPLCMS Method development and Validation of Amlodipine, Hydrochlorothiazide and Losartan in Combined tablet dosage form	Column-ACQUITY BEH C18(1.7 µm,2.1 ×50mm) Mobile phase-Acetonitrile &1% Ammonium acetate Lineaity-50-300ng.mL^{-1},125-750ng.mL^{-1},500-3000ng.mL^{-1} Flow rate-4.0mL^{-1}
58	Darshana A.Parmar, Dinesh. Thakkar, Rashmin B.Patel, Mrunali R.Patel[59]	Thai Journal of Pharmaceutical Sciences,2015	HPTLC Method for Simultaneous Estimation of Ramipril and Losartan potassium in pharmaceutical dosage form	Column-Aluminum-backed layer of silica gel 60F254 Mobile phase- Methanol: Ethyl acetate: Toluene: Glacial acetic acid (1:9:1:0.2v/v/v/v) λmax -210nm Linearity-300-1300ng/spot,3000-13000ng/spot Recovery98.93-99.73,98.96-100.11%
59	Kanchan Shelar, Janhavi R.Rao, Chaitali Dhale[60]	International Journal of Pharmaceutical Sciences and Research,2019	Stability Indicating HPTLC Method development and Validation for Simultaneous Estimation of Amlodipine besylate & Losartan potassium and Characterization of acid degradant product of Losartan	Column-TLC aluminum plates pre-coated with silica gel 60F Mobile phase - Chloroform: Methanol: Acetic acid (5.5:2.5:2.0.05v/v/v/v) λmax -237nm LOD-24.46,10.82ng/spot LOQ-74.14,32.80ng/spot

CONCLUSION

According to this review different spectroscopic and chromatographic methods for losartan potassium are available for single and combination analysis, and the mobile phase containing acetonitrile is common for most of the chromatographic methods. It was observed that the most common combination of losartan potassium is with atenolol. For most of the spectroscopic methods, the common solvent is methanol. Most of the methods were RP-HPLC and UV absorbance detection because these methods provided the best available reliability, reproducibility, and accuracy.

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CONFLICT OF INTERESTS

The authors declared that there is no conflict of interests.

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