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Advancements in Analytical Development: Unveiling the Potency of Rosuvastatin Calcium and Telmisartan

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ABSTRACT
Atherosclerosis and Hypertension are major life-threatening diseases now a days and because of that, physicians and researchers are focusing on new innovative treatments and drug development for these diseases. Analytical development is the most useful and unavoidable part of the identification and impurity profiling of drugs. Rosuvastatin Calcium and Telmisartan is one of the marketed combined tablet dosage form that is used to treat patients having atherosclerosis with hypertension. Rosuvastatin Calcium belongs to the class of antihyperlipidemic and acts by blocking the HMG-CoA reductase whereas Telmisartan belongs to the class of antihypertensive and acts by blocking the RAS pathway. There are various analytical developments available for the estimation of these drugs including HPLC, UV Spectrophotometers, HPTLC, and RP-HPLC which are described in this article, apart from that, the RP-HPLC is the most frequently used method with isocratic illusion.
Keywords: *Rosuvastatin Calcium, Telmisartan, UV Spectrophotometer, RP-HPLC, HPTLC.*

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Abbreviations:
HPLC: High-Performance Liquid Chromatography,
RP-HPLC: Reverse Phase High-Performance Liquid Chromatography,
HPTLC: High-performance thin Layer Chromatography,
HMG-CoA: 3-Hydroxy-3-Methyl Glutaryl-Coenzyme A,
RAS: Renin-Angiotensin System,
ACE: Angiotensin-Converting Enzyme,
DMSO: Dimethyl sulfoxide.
UV spectrophotometer: Ultraviolet spectrophotometer
FR: flow rate
SP: stationary phase
Mp: mobile phase
Rf: retention factor

INTRODUCTION

The overview emphasized on analytical development of Rosuvastatin Calcium and Telmisartan which belong to the class antihyperlipidemic and antihypertensive respectively and are used to treat atherosclerosis with high blood pressure [1].

Atherosclerosis: atherosclerosis arises due to the impaired filtration of low-density lipoproteins, and oxidative stress leads to inflammation and lesion formation with the accumulation of dead smooth muscle cells, macrophages, cytotoxic T-lymphocytes in the intima of the artery resulting in the thrombus formation causes the turbulent blood flow [1].

Hypertension: Hypertension arises due to increased levels of renin in the body which leads to the conversion of the inactive renin substrate to angiotensinogen-I and then angiotensinogen-II with the help of angiotensin-converting enzyme (ACE) which is the potent vasoconstrictor [2][3][4].

Rosuvastatin Calcium: It is a white to beige-coloured amorphous powder that is showing its therapeutic response by inhibiting the conversion of HMG-CoA to mevalonate by restricting the HMG-CoA reductase [5][6][7]. It is chemically known as calcium;7-[4-(4-fluorophenyl)-2- [methyl (methyl sulfonyl) amino]-6-propan-2-ylpyrimidin-5-yl]-3,5- dihydroxyhept-6-enoate which is slightly soluble in water, soluble in DMSO, melted at 122 – 125 °C and starts to boil at the temperature of 261-263 °C [7][8][9]. Rosuvastatin has a molecular weight of 1001.1 g/mol and the molecular formula is $C_{44}H_{54}CaF_2N_6O_{12}S_2$ [8].

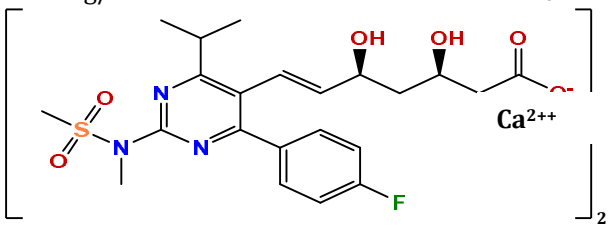

Fig 1: Structure of Rosuvastatin Calcium

Telmisartan: It is a white to slightly yellowish crystalline powder that shows its therapeutic Response by blocking the angiotensin II receptor [10]. It is chemically known as 2- [4- [[4-methyl-6-(1- methyl benzimidazole-2-yl)-2- propyl benzimidazole-1- yl] methyl] phenyl] benzoic acid which is practically insoluble in water, soluble in DMSO, Mets at 261-263 °C and starts to boil at the temperature of 771.9 -776 °C [10][11]. Telmisartan has a molecular weight of 514.6g/mol and its molecular formula is $C_{33}H_{30}N_4O_2$ [10].

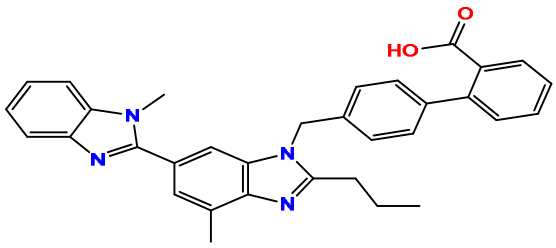

Fig 2: Structure of Telmisartan

Analytical Technique:

HPTLC: The main separation principle of HPTLC was based on the adsorption phenomenon which depends on the affinity of solute components towards the SP. It is the advanced version of TLC and gives more precise results [28]

- **o Instrumentation of HPTLC [29]:**
- **a.** Precoated TLC plate
- **b.** Micro syringe
- **c.** Development chamber
- **d.** Sample applicator
- **e.** Scanner and Detector
- **o Applications [28]:**
- **a.** Applied in Forensic Sciences
- **b.** In Impurity Profiling
- **c.** In Clinical Studies
- **d.** In natural products detection
- **e.** In QC department etc.

ANALYTICAL FINDINGS

Pharmacopeial Methods as per IP:

- **IP (2022):** The Chromatographic estimation of Rosuvastatin Calcium was done by HPLC using SF of Stainless-steel column with particle size of 5 µm and followed by the dimension of 25 cm x 4.6 mm with Ammonium Acetate, Acetonitrile, Tetrahydrofuran in the ratio of 5:8:4 respectively as an Mp and the pH is adjusted by 5 with the help of Glacial Acetic Acid along with 1.5 ml/min of FR. All of this operation was performed on the wavelength of 248 nm [12].
- **IP (2022):** According to the Indian Pharmacopoeia the estimation of Telmisartan was done by HPLC using the Mp A including Orthophosphoric Acid with pH adjustment at 3 by Potassium Hydrogen

Phosphate and Sodium Pentanerulphonate Monohydrate and B Including Methanol, Acetonitrile in the ratio of 20 and 80 respectively. It was performed at 230nm with 1 ml per minute of FR [13].

Non-Pharmacopeial Methods:

- Deshmukh TB et al; In this article, the authors stated that the Atorvastatin Calcium and Telmisartan estimated the RF of 0.17 and 0.49 respectively at the wavelength of 289 nm by HPTLC. The solvents chloroform, Methanol, Toluene, and Ammonia are used in the ratio of 5:2:1:0.2 respectively as an Mp with the SP of silica gel 60 F254 [14].
- Atia NN et al; The article depicts that, the HPTLC was performed by utilizing Mp Chloroform, Methanol, and Glacial Acetic Acid (68: 11.2: 0.8 v/v/v) was utilized to detect the retardation factor of Atorvastatin Calcium (0.77) and Trimetazidine hydrochloride (0.39) at 246 nm and 230 nm respectively with the SP of silica gel 60 F254 [15].
- Chokshi A et al; The author discovered that the retardation factor of Chlorthalidone, Metoprolol Succinate, and Telmisartan was found to be 0.40, 0.69, and 0.27 respectively using the Mp Toluene, Methanol, Ethyl acetate and triethylamine in the volume-to-volume ratio of 4:0.8:1: 1.2. HPTLC estimation performed on 255 nanometres utilizing SP of silica gel 60 F254 [16].
- Prabhu C et al; The determination of Telmisartan by HPTLC utilizing the silica gel 60 F254 as an SP at 297 nm. Chloroform, Methanol (8.6:1.4 v/v) containing 0.1% Ammonia was used as an Mp to obtain the Rf of 0.43 [17].
- El-Gizawy SM et al; The HPTLC was performed at 230 nm to obtain the retardation factor 0.37, 0.73, 0.52 of Empagliflozin, Pioglitazone, and Rosuvastatin respectively using the Mp Ethyl Acetate, N-Hexane, Glacial Acetic Acid and Methanol (4:4.2:0.05:1.75 v/v/v/v) and silica gel 60 F254 as an SP [18].
- Supe DR et al; The author discovered that the retardation factor of Rosuvastatin Calcium was found to be 0.45 using the Ethyl Acetate, Toluene, and Methanol in the volume-to-volume ratio of 3:5:2 as an Mp. The detection of HPTLC was performed at 242 nm utilizing the SP of silica gel 60 F254 [19].
- Chandurkar SN et al; The determination of Telmisartan by HPTLC utilizing the silica gel 60 F254 as an SP at 299 nm. Toluene and Methanol in the ratio of 7:3 volume by volume were used as a Mp to obtain the Rf of 0.46 [20].
- Lakshmi KS et al; The HPTLC was performed at 212 nm to obtain the retardation factor 0.43, 0.22 of Telmisartan and Ramipril respectively using the Mp Toluene, Acetonitrile, Water, and Formic Acid in the volume-to-volume ratio of 5:5:1:0.3 and silica gel 60 F254 as an SP [21].
- Ilango K et al; The author discovered that the retardation factor of Telmisartan and Atorvastatin was found to be 0.37 and 0.63 respectively using the Mp Ethyl Acetate, Toluene, Acetic Acid, Methanol (1:5:0.3:1 v/v). The detection of HPTLC was performed at 279 nm utilizing the SP of silica gel 60 F254 [22].
- Potale L V. et al; The HPTLC was performed at 210 nm to obtain the retardation factor 0.68 and 0.38 of Telmisartan and Ramipril respectively using the Mp Methanol, Chloroform (1:6 v/v) and SP silica gel 60 F254 [23].
- Butle S et al; The determination of Telmisartan and Cilnidipine by HPTLC utilizing the silica gel 60 F254 as an SP at 260 nm. Toluene, Methanol, and Glacial Acetic Acid (8: 2: 1 v/v/v) were used as an Mp to obtain the Rf of Telmisartan (0.38) and Cilnidipine (0.62) [24].
- Marolia BP et al; The article depicts that, the HPTLC was performed by utilizing Butanol, Chloroform, and Ammonium in the ratio of 4:6:0.1 as an Mp was utilized to detect the retardation factor of Amlodipine Besylate (0.27), Hydrochlorothiazide (0.43) and Telmisartan (0.14) at 254 nm with the SP of silica gel 60 F254 [25].
- Deshmukh TB et al; The Chromatographic separation of Atorvastatin Calcium and Telmisartan was done by reverse phase HPLC using SP of Chemsil C18 column with the dimension of 150 mm × 4.6 mm having particle size of 5 µ with the Mp of 0.02 M Ammonium Acetate buffer with pH 4 which is adjusted by Glacial Acetic, Acetonitrile, Tetrahydrofuran in the ratio of 400:400:14 respectively with the 1.5 ml/min of FR. The whole operation was performed on the wavelength of 246 nanometres and Atorvastatin Calcium along with Telmisartan was retained in 5.70 min and 6.72 min respectively [26].
- Mostafa EA et al; According to the author, the estimation of Aspirin, Clopidogrel, Atorvastatin and Rosuvastatin was done by RP-HPLC using the Mp A including Acetonitrile, Water in the ratio of 80:20 and B Including 20 mM Potassium Dihydrogen Phosphate Buffer with pH 3.2 which is adjusted by O-Phosphoric Acid. The detection was done at 230 nm with a FR of 1ml/min. The retention time of Aspirin, Clopidogrel, Atorvastatin and Rosuvastatin was found to be 1.27 min, 6.90 min, 5.55 min and 4.45 min respectively [27].

CONCLUSION

The whole article depicts the Rosuvastatin Calcium and Telmisartan estimation alone or in combination with different methods of analysis including RP-HPLC, HPLC, and HPTLC including pharmacopeial and non-pharmacopeial methods. According to the literature survey, we cannot negotiate that, the mostly used method was HPTLC among the aforementioned methods in this article. The overall survey shows all advancements in analytical development in the estimation and determination of Rosuvastatin Calcium and Telmisartan which will help the further study of analytical development on these drugs as well as can be used as a reference for other drugs for their analytical development too.

REFERENCES

1. Salekeen R, Haider AN, Akhter F, Billah M, Islam E, Islam KMD. (2022). Lipid oxidation in pathophysiology of atherosclerosis: Current understanding and therapeutic strategies. International Journal of Cardiology Cardiovascular Risk and Prevention, 14:1-16.
2. Burnier M and Wuerzner G. (2015). Pathophysiology of hypertension. Pathophysiology and Pharmacotherapy of Cardiovascular Disease, 655-683.
3. Harrison DG, Coffman TM, Wilcox CS. (2021). Pathophysiology of Hypertension. Circulation Research, 128:847–863.
4. Beevers G, Lip GYH, O'Brien E. (2001). The pathophysiology of hypertension. Clinical review, 322:912-916.
5. AstraZeneca group of companies. (2005). CRESTOR (rosuvastatin calcium) tablets, Rev 01/05:1-20
6. Mode of Action of Rosuvastatin Calcium. https://medlineplus.gov/druginfo/meds /a603033.html#: ~:text= Rosuvastatin%20is%20 in%20a%20class, other%20parts%20of%20the%20body, Assessed on 26/01/2024.
7. Physiochemical Properties of Rosuvastatin Calcium. https://www.chemicalbook.com /Chemical Product Property_EN_CB9482678.htm, Assessed on 26/01/2024.
8. Physiochemical Properties of Rosuvastatin Calcium. https://pubchem.ncbi.nlm.nih.gov/compound/Rosuvastatin-Calcium, Assessed on 26/01/2024.
9. Physiochemical Properties of Rosuvastatin Calcium. https://www.chemsrc.com/en/cas/147098-20-2_1084749.html, Assessed on 26/01/2024.
10. Physiochemical Properties and Mode of Action of Telmisartan. https://pubchem.ncbi.nlm.nih.gov /compound/Telmisartan, Assessed on 26/01/2024.
11. Physiochemical Properties of Telmisartan. https://www.chemicalbook.com /Chemical Product Property_ EN_CB4266172.htm#:~:t ext=ChEBI%3A%20Telmisartan%20is%20a%20member,xenobiotic%20and%20an%20environmental%20contaminant, Assessed on 26/01/2024.
12. Indian Pharamacopoeia. (2022). Edition 9th. Volume 3rd. page 3530.
13. Indian Pharamacopoeia. (2022). Edition 9th, Volume 3rd, page 3726.
14. Deshmukh TB and Deo S. (2018). Development and validation of novel HPTLC method for the simultaneous estimation of Atorvastatin Calcium and Telmisartan in tablet dosage form. IJPCBS, 8(1):82–90.
15. Atia NN, Tawfeek HM, Rageh AH, El-Zahry MR, Abdelfattah A, Younis MA. (2019). Novel sublingual tablets of Atorvastatin calcium and Trimetazidine hydrochloride combination; HPTLC quantification, in vitro formulation and characterization. Saudi Pharm J, 27(4):540–549.
16. Chokshi A, Prajapati R, Desai P, Vyas N. (2022). HPTLC-Densitometric method for assay of Chlorthalidone, Metoprolol Succinate and Telmisartan in combined pharmaceutical formulation. J Chem Metrol, 16(2):90–101.
17. Prabhu C, Subramanian GS, Karthik A, Kini S, Rajan MS, Udupa N. (2007). Determination of Telmisartan by HPTLC - A stability indicating assay. J Planar Chromatogr - Mod TLC, 20(6):65–69.
18. El-Gizawy SM, Atia NN, Ali MFB, Rushdy DH. (2023). Development of a highly sensitive and eco-friendly High-Performance Thin-Layer Chromatography approach for the determination of Empagliflozin, Pioglitazone, and Rosuvastatin simultaneously in pharmaceutical preparations and different biological fluids. J Planar Chromatogr - Mod TLC,
19. Supe DR, Deshpande PB, Jadhav S and Swami S. (2021). Stability indicating High Performance Thin Layer Chromatography method development and validation for estimation of Rosuvastatin Calcium as bulk drug and in tablet dosage form. European Journal of Biomedical and Pharmaceutical Sciences, 8(9):664–671.
20. Chandurkar SN and Phoujdar MS. (2017). Development and validation of HPTLC method for determination of Telmisartan in API and pharmaceutical dosage form. World J Pharm Sci. 5(5):195–199.
21. Lakshmi KS, Lakshmi S And Pal K. (2010). Stability indicating HPTLC method for simultaneous determination of Telmisartan and Ramipril in tablets. Int J Pharm Pharm Sci, 2(4):127-129.
22. Ilango K, Shiji Kumar PS. (2013). Development and validation of stability indicating HPTLC and HPLC methods for simultaneous determination of Telmisartan and Atorvastatin in their formulations. J Chem, 1-9.
23. Potale L V., Damle MC, Khodke AS, Bothara KG. (2010). A validated stability indicating HPTLC method for simultaneous estimation of Ramipril and Telmisartan. Int J Pharm Sci Rev Res, 2(2):35–9.
24. Butle S and Padmanabh D. (2015). Development and validation of stability-indicating HPTLC method for simultaneous determination of Telmisartan and Cilnidipine in combined tablet dosage form. Int J Pharm Sci Drug Res, 7(6):478–483.

25. Marolia BP, Bodiwala KB, Shah SA, Prajapati PB, Satani BH, Desai SA. (2016). Development and validation of HPTLC method for simultaneous estimation of Amlodipine Besylate, Hydrochlorothiazide and Telmisartan in their combined tablet dosage form. Pharm Methods, 7(1):48–53.
26. Deshmukh TB, Deo SS, Inam FS. (2018). Development and Method Validation of Atorvastatin Calcium and Telmisartan in Tablet Dosage form by RP-HPLC Method, 6(1):16– 24.
27. Mostafa EA, El-Ashrey MK, Mahmoud ST. (2023). An innovative combination of BoxBehnken design and ecofriendly approaches for the simultaneous determination of aspirin, clopidogrel, atorvastatin and rosuvastatin in their fixed-dose combination tablets. BMC Chem, 17(164):1–20.
28. HPTLC. https://kusicc.ac.in/hptlc2/#:~:text=Principle%20of%20HPTLC%20have%20similar,their%20affinities%20towards%20the%20adsorbent. Assessed on 26/01/2024.
29. Pallavi Ambati P, Bala KP, Srinivasa RY, Varaprasada RK and Deepthi R. (2021) Instrumentation and future prospects of HPTLC- a review. World Journal of Pharmaceutical Research, 10(6): 650-661.

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