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Simultaneous Estimation and Degradation Studies of Azelnidipine and Telmisartan by UPLC

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Abstract: The inventive request concentrates on product proposed to increase an ensimple,sensitive, rapid, propound, extremely strength showing RP-UPLC viewpoint for synchronous evaluation of Azelnidipine and Telmisartan tablet dose structure, Chromatographic detachment was performed with water siphoned at a stream pace of 1 ml/sec, the Hibar C18 [100×2.1 mm, 2 µ] section and portable stage acetonitrile are made out of half v/v water (pH 4.0). A 30°C superior section temperature and a 258.0 nm picked frequency both utilized. It has been demonstrated that Azelnidipine and Telmisartan have retention times of 1.468 and 1.962 min, respectively. The level of the RSD for Telmisartan and not set in stone to be 0.6 and 2.4, separately. For Telmisartan and Azelnidipine, the recuperation percent were 100.59% and 99.63%, individually. LOD and LOQ value's found to be 1.09, 00.18, and 00.36, 0.06 obtained from the regression equations for Telmisartan and Azelnidipine, respectively. Azelnidipiney = 18819x + 147.54 and Telmisartanis y = 18974x + 2744.9 are the relapse at each stage, the per cent relative standard qualities were under 2, showing a good level of precision and accuracy. satisfied the acknowledgment standards by completing the heartiness test. As per the proposals of the ICH, a pressure study was led out utilizing the certified working norms of Telmisartan and Azelnidipine. The results showed that the created UPLC-Strategy was security demonstrating.

Keywords: UPLC, Simultaneous estimation, Degradation studies**,** Azelnidipine, Telmisartan

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Introduction

Azelnidipine (3-[1-azetin-3-yl (diphenylmethyl)] 5-propan-2-yl 2-amino4-(3-nitrophenyl)-6-methyl 3,5-dicarboxylate-1,4-dihydropyridine; $C_{33}H_{34}N_4O_6$ (Fig. 1), melting point 193-195°C is a medication that specifically targets the trans-membrane flow of calcium ions (Ca^{2+}) in the voltage-dependent smooth muscle channels found within the vascular walls. It primarily affects the L-type calcium channels, which include subtypes such as L, T, N, P/Q, and R-types. By inhibiting these channel's (Karlberg *et al*., 1999; Balt *et al*., 2001; Chen *et al*., 2015) aznidipine prevents influx of Ca^{2+} ions into

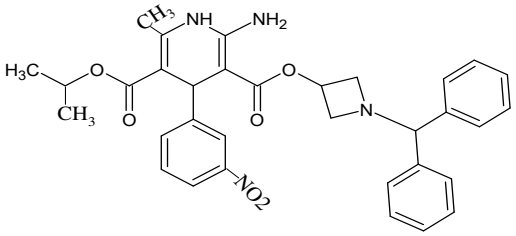

Fig. 1: Azelnidipine.

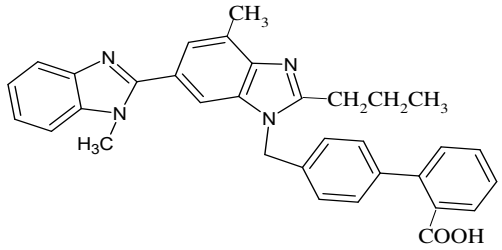

Fig. 2: Telmisertan.

the cells, thus reducing the likelihood of smooth muscle contraction (Reema and Joshi, 2013). In normal physiological conditions, smooth muscle contraction is initiated by an increase in intracellular calcium levels, which ultimately leads to hypertension. However, when azelnidipine is administered, it causes the calcium channels to close, preventing calcium from entering the cells (Rele, 2015). This action results in the relax the vascular softmuscle cells then an subsequent decrease in an BP (Blood Pressure) (Korolkovas, 1988). Additionally, azelinidipine's mechanism action helps in reducing arterial stiffness and plaque formation, contributing to an overall improvement in cardiovascular health (Santosh and Venkateshwar, 2014).

Telmisartan [(2-Propyl-1,4-dimethyl-[2,6-Di-1 H- benzimidazol] 1_yl]] - [Diphenyl – 1 - 1] 2-Carboxylic acid; $C_{33}H_{30}N_4O_2$ (Fig. 2) (Beale and Block, 2004) is a medication that works in a binding reversibly and selectively specific receptor, particularly the angiotensin II AT1 receptors, found in the adrenal gland and vascular smooth muscle (Ram, 2015). It competes with angiotensin II for attachment to these receptors, thereby inhibiting the actions of angiotensin II, a hormone that causes blood vessels to constrict and stimulates the production and release of aldosterone (Mukhopadhyay *et al.*, 2011). By blocking the effects of angiotensin II, telmisartan leads to a decrease in systemic vascular resistance, which results in improved blood flow and reduced blood pressure. Unlike other pharmaceutical drigs, Telmisortan does not interfere with an angiotensi-nogen-converting enzyme, erstwhile hormonal receptors, or an ion channel's. Additionally, research has suggested that telmisortan function as an partial agonistic of peroxisomal prolife-rators-activatig receptor gamma (PPARγ) a molecular target for drugs used to treat high blood sugar levels (Patel and Patel, 2014). This partial activation of PPARγ allows telmisartan to regulate insulin resistance, optimize lipid and carbohydrate metabolism, and avoid the potential side effects associated with full PPARγ activators (Wankhede and Tajne, 2007). This multifaceted mechanism of action contributes to the overall cardiovascular and metabolic benefits of telmisartan therapy.

Materials and Methods

Telmisartan and Azelnidipine, uncontaminated drugs (API), combination Telmisartan and Azelnidipine tablets, (Telma AZ), deionised H_2O, Phosphate Buffer, Acetonitrile, carbinol, Ortho-Phosphoric acid, Pot. Dihydrogen Ortho Phosphate Buffer are from Rankem.

Devices used are - Electronic-Balance (Deniver); pH- Meter (BVK - India); Ultrasonicator (BVK -Enterprises); The Water UPLC, 02695-System : Outfitted with an 4^o pump that are an auto analyzer with Empower-2 programme incorporated, and a photo diode's array detector. For evaluating the absorbances of telmisortan and azelnidipine solutions, PG Devices T60 UV-VIS Spectrophotometers with unique band widths of 2 mm and 10 mm and associated quartz cells integrated an UV-win 6 Programme were utilised.

Analysis Method:

Diluent:

Depends upon drugs olubility, Solvents were selected, Acetonitrile and H_2O taken into account the fraction is 50:50.

Standard Stock Solution Preparation:

To set up an intensified prescription containing 20 mg of Telmisartan and 4 mg of Azelnidipine, follow these steps: Carefully gauge and precisely measure 20 mg of Telmisartan and 4 mg of Azelnidipine utilizing proper gauging equipment. Transfer both estimated doses into a spotless, dry, and fittingly estimated (50 ml) volumetric container, added 10 ml of dilution solution and Sonicate the combination for 10 min to guarantee exhaustive disintegration and homogeneity of the medication (Wan *et al*., 2014). After sonication, make up the volume to the last 50 ml with reasonable diluents. This will bring about a grouping of roughly 80 µg per ml for Azelnidipine and 400 µg per ml for Telmisartan in the last solution (Reema and Joshi, 2013). Ensured to follow legitimate aseptic methods and security measures while taking care of the meds and gear. Continuously talk with a certified medical services proficient or drug specialist for direction on intensifying prescriptions, as this data is accommodated illustrative purposes as it were (Rowan *et al*., 2014).

Standard working solution Preparation (*100 per cent solution*):

One ml each of two stock solutions mentioned above was added to a 10 ml graduated container (40 µg/ml Telmisartan, and 8 µg/ml of Azelnidipine).

Sample stock solutionspreparation:

Label Claim: (Telma_Az) Telmisartan and Azelnidipine (40 mg and 8 mg) precisely measured the corresponding weight of the combination powdered drug transfer into a100 ml volumetric flask, and added 50 ml solvents sonicating at 25 min, the quantity again make up with solvent and filter through milli-Q filter (80 µg/ml azelnidipine and 400 µg/ml telmisartan).

Working (*Sample*) *solutions preparation* (*100 per cent solution*):

1 ml of the above filtered sample stock solution taken into 10 ml graduated flask and make up to 10 ml (80 µg/ml Azelnidipine and 40 µg/ml telmisartan).

Buffer (*0.01N, KH_2PO_4*) *solution preparation*: A volumetric carafe containing 10 ml was diluted with 1 ml of the sifted test stock arrangement (80 µg/ml Azelnidipine and 40 µg/ml telmisartan)(Koike, 2002).

Results and Discussion

System Suitability-Parameters:

Standard solutions of 40 mg/ml Telmisortan and 8 mg/ml Azelinidipine were prepared and six times injected for determination of system suitability parameter's (Table 1) including Peak tailing, USP Plate Count and Resolution, the rate RSD for a area an 6 paradigm infusions grades ought to no over two per cent (System suitability chromatogram shown in Fig. 3).

Specificity:

In the context of studying the maintenance periods of Azelnidipine and Telmisartan, it was observed that the half-life (t1/2) of Azelnidipine was 1.100 min, while that of Telmisartan was 0.1800 min (Jain *et al*., 2011). During the investigation, no interference or overlapping peaks were detected in the clear and authentic treatment samples at the respective maintenance periods for these medications (shown in Blank chromatogram Fig. 4; placebo Fig. 5). This finding suggests that the technique employed in this study was effective in accurately measuring and distinguishing the two drugs, providing clear and reliable results.

Accuracy:

Standard stock –solution preparation:

Precisely measured and transfered 20 mg of Telmisartan and 4 mg of Azelnidipine using working standards into 50 ml dry graduated flasks. Then, 10 ml of diluent was added, the flasks were sonicated for 10 min and diluents were used to bring the final volume up to 400 µg of Telmisartan and 80 µg of Azelnidipine. The

Table 1: Parameters of system suitability of azelnidipine and telmisartan

S. No.	Azelnidipine			Telmisartan			
Injection	Rt (min)	USP – Plate Count	USP Tailing	Rt (min)	USP- Plate Count	USP Tailing	USP Resoluton
1	1.462	3410	01.26	01.953	4485	01.36	4.3
2	1.466	3313	01.27	01.956	4563	01.35	4.5
3	1.467	3391	01.25	01.962	4484	01.37	4.4
4	1.468	3352	1.26	1.962	4441	1.36	4.3
5	1.468	3429	1.27	1.962	4375	1.36	4.3
6	1.472	3464	1.27	1.967	4453	1.37	4.4

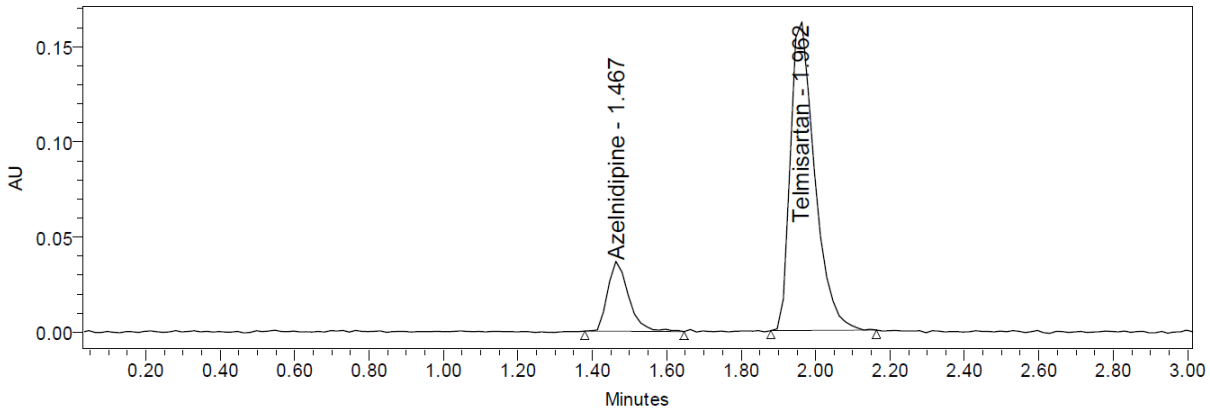

Fig. 3: System suitability Chromatogram.

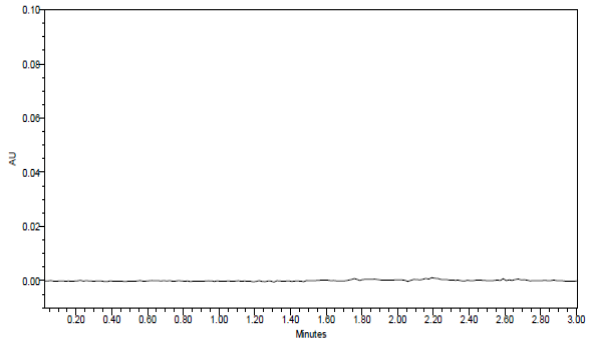

Fig. 4: Chromatogram of blank.

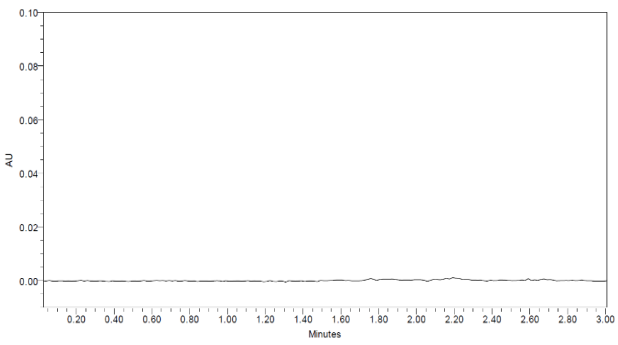

Fig. 5: Chromatogram of Placebo.

Accuracy values are listed in Table 2.

Preparation of a 50 per cent spiked solution:

0.5 ml of Taster-Reserve Solution was taken into a 10 ml graduated container then added 1 ml from each paradigm reserve solution and make up to neck mark with the solvent. The Accuracy, 50% Chromatogram of Azelnidipine and Telmisartan are shown in Figure 6.

100% Spiked Solution Preparation:

1 ml of Sample Stock Solution was taken into 10 ml graduated flask, then added 1 ml from each Standard stock solution and make up to the neck mark with solvent. Accuracy, 100% Chromatogram of Azelnidipine and Telmisartan are shown in Figure 7.

Preparation of (150%) Spiked Solution:

Table 2: Accuracy Table of Azelnidipine and Telmisartan

Accuracy of Azelnidipine					Accuracy of Telmisartan			
% LEVEL	AMOUNT SPIKED (µg/ml)	AMOUNT RECOVERED (µg/ml)	PERCENTAGE RECOVERY	MEAN % RECOVERY	AMOUNT SPIKED (µg /ml)	AMOUNT RECOVERED (µg/ ml)	PERCETAGE RECOVERY	MEAN % RECOVERY
50%	4	4.0	99.6	100.77	20	20.38	101.90	100.09
	4	4.1	101.3		20	19.84	99.20	
	4	4.0	100.3		20	20.29	101.47	
100%	8	8.1	101..3		40	39.81	99.53	
	8	8.0	100.3		40	40.24	100.60	
	8	8.1	101.2		40	40.12	100.29	
150%	12	12.2	101.8		60	59.70	99.50	
	12	12.1	100.8		60	59.26	98.76	
	12	12.0	100.4		60	59.72	99.54	

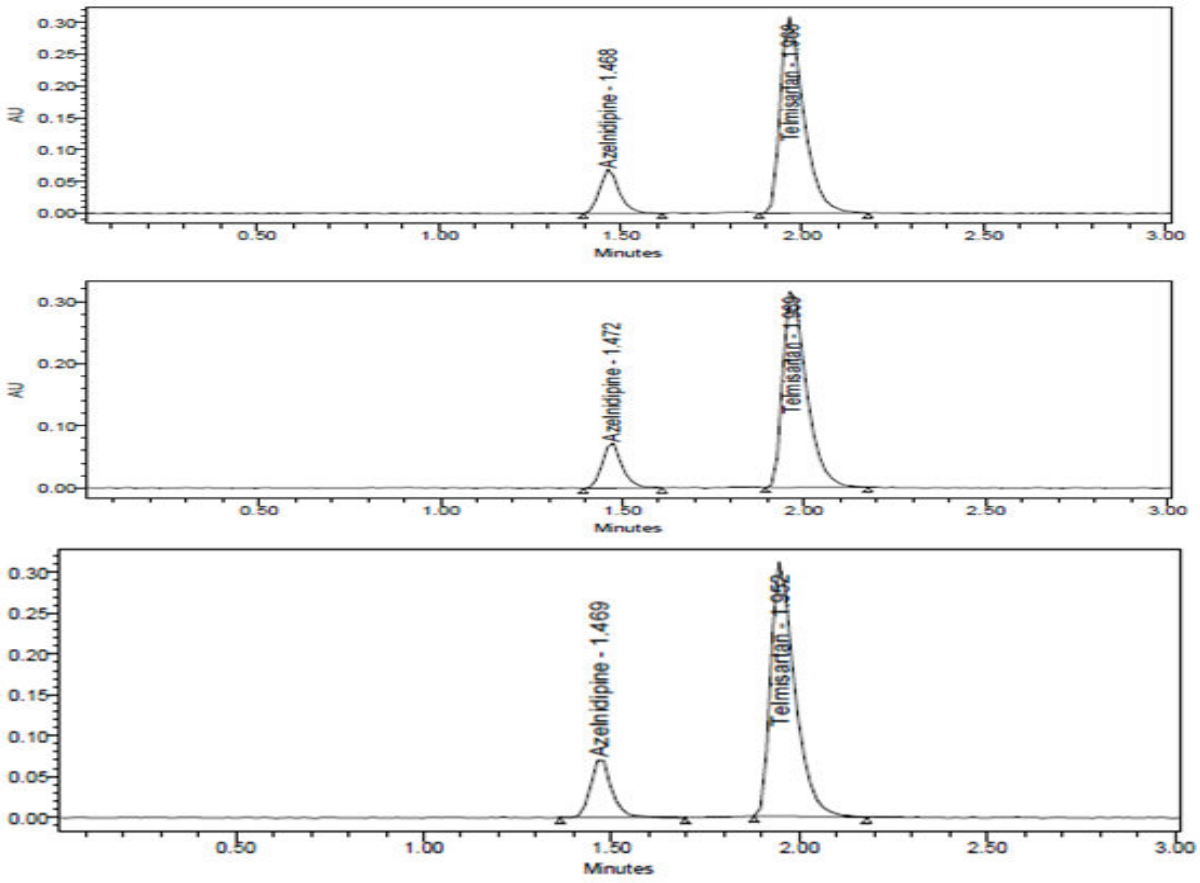

Fig. 6: Accuracy, 50% Chromatogram of Azelnidipine and Telmisartan.

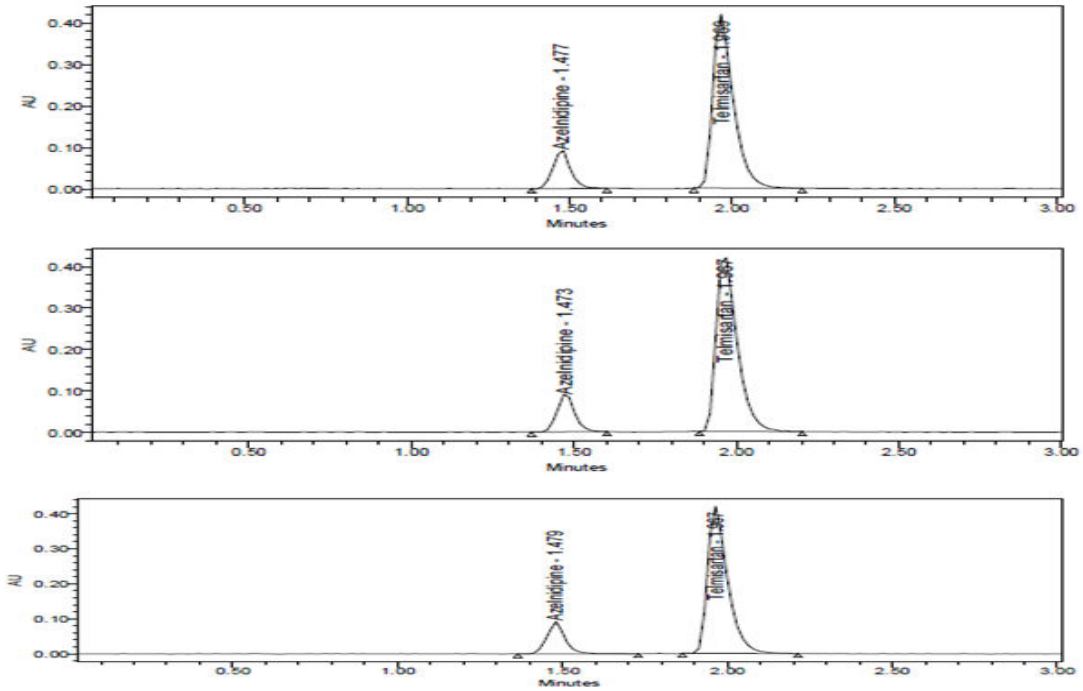

Fig. 7: Accuracy, 100% Chromatogram of Azelnidipine and Telmisartan.

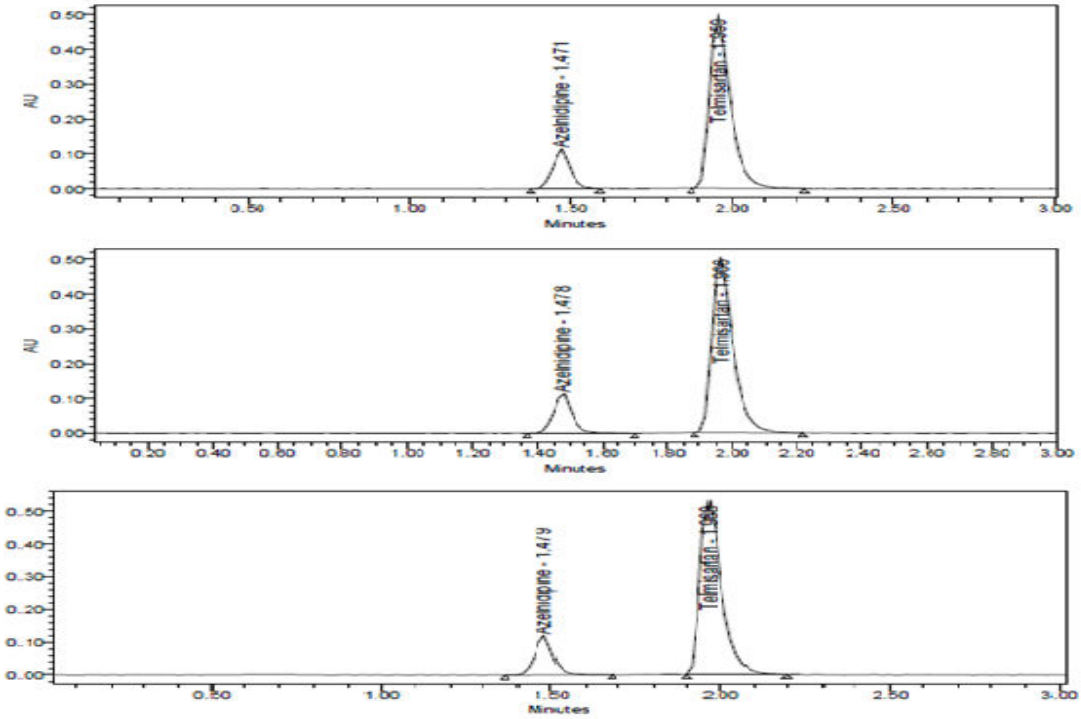

Fig. 8: Accuracy, 150% Chromatogram of Azelnidipine and Telmisartan.

Table 3: System precision table of azelnidipine and telmisartan

S. No.	AREA OF AZELNIDIPINE	AREA OF TELMISARTAN
1	149589	743479
2	147575	753688
3	148582	746006
4	141377	742070
5	149618	744335
6	151501	750270
Mean	148040	746641
S.D	3514.9	4459.7
%RSD	2.4	0.6

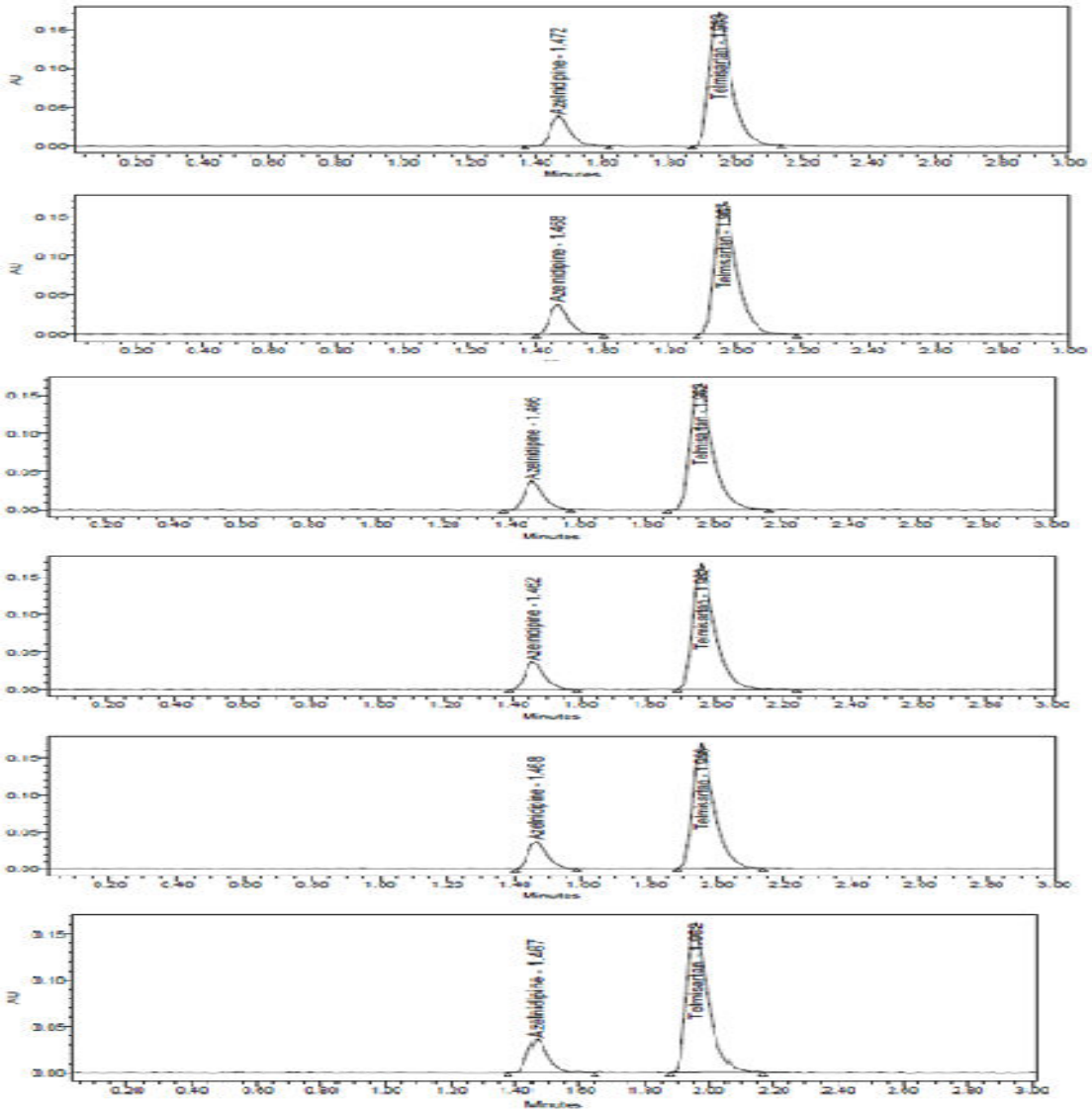

Fig. 9: System Precision Chromatograms.

Table 4: Linearity

S, No.	Pipetted from stock (ml)	Volume of flask (ml)	Concentration in ppm (Telmisartan)	Concentration in ppm (Azelnidipine)	% Linearity Level
1	0.25	10	10	2	25
2	0.5	10	20	4	50
3	0.75	10	30	6	75
4	01	10	40	8	100
5	125	10	50	10	120
6	1.5	10	60	12	150

Table 5: Linearity table for Azelnidipine and Telmisartan

	AZELNIDIPINE		**TELMISARTAN**	
	Concentration (µg/ml)	PEAK AREA	**Concentration (µg/ml)**	PEAK AREA
1	0	0	0	0
2	2	37743	10	203336
3	4	74613	20	377814
4	6	115202	30	563055
5	8	149313	40	767617
6	10	188391	50	946234
7	12	223596	60	1145713

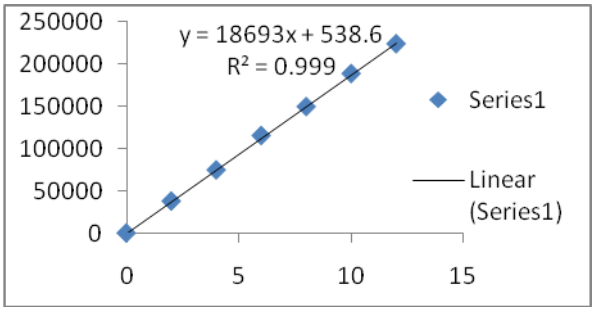

Fig. 10: Calibration curve of Azelnidipine.

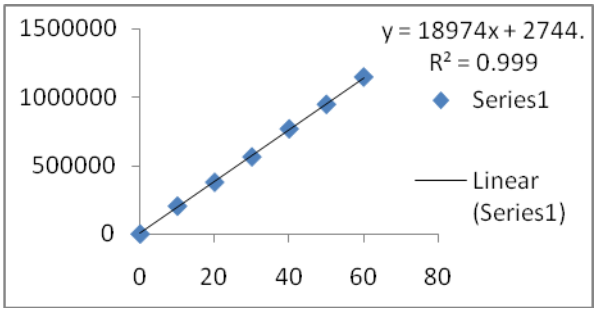

Fig. 11: Calibration curve of Telmisartan.

Table 6: Telmisartan with Azelnidipine Robustness Data

S. No.	**Condition**	**%RSD AZELNIDIPINE**	**%RSD TELMISERTAN**
1	Flow rate (Minus) 00.9 ml/min	0.7	1
2	Flow rate (Plus) 1.1 ml/min	1.0	0.7
3	Mobile phase (Minus) 45B:55A	0.9	1.1
4	Mobile phase (Plus) 55B:45A	1.2	0.3
5	Temperature (Minus) 25°C	0.8	0.8
6	Temperature (Plus) 35°C	0.4	0.4

1.5 ml of Sample Stock Solution was added into a 10 ml graduated flask, then added 1 ml from each standard stock solution and make up to the mark with diluent. Accuracy, 150% Chromatogram of Azelnidipine and Telmisartan are shown in Figure 8.

Precision:

Standard stock solution preparation:

mg of azelnidipine were precisely gauged and moved to 50 ml dry volumetric jars. 10 ml of diluent was then added, and the jars were sonicated for 10 min before diluents were added to make up the leftover volume.

Preparation of 100 per cent Standard Working Solution:

1 ml from the above 2 Stock Solutions were taken in 10 ml graduated volumetric flask and make up to 10 ml (40 µg/ml telmisartan, and 8 µg/ml of azelnidipine). The obtained precision values are mentioned in Table 3 and chromatograms are shown in Figure 9.

25 per cent (25%) standard arrangement: Taken 0.25 ml of each of the 2 standard stock arrangements and made up to 10 ml (10 µg/ml Telmisartan and 2 µg/ml Azelnidipine).

50 per cent (50%) standard arrangement: 0.5 ml each from 2 Standard Stock arrangements was taken and made up to 10 ml (20 µg/ml Telmisartan and 4 µg/ml Azelnidipine).

75% (75 per cent) standard arrangement: 0.75 ml each from 2 standard stock arrangements was pipetted out and make up to 10 ml (30 µg/ml Telmisartan and 6 µg/ml Azelnidipine).

100% (100 per cent) standard arrangement: 1 ml each from 2 standard stock arrangements was pipetted out and make up to a 10 ml (40 µg/ml Telmisartan and 8 µg/ml Azelnidipine).

125% (125 per cent) standard arrangement: 1.25 ml each from 2 standard stock arrangements was pipetted out and made up to a 10 ml (50 µg/ml Telmisartan and 10 µg/ml Azelnidipine).

150% (150 per cent) standard arrangement: 1.5 ml each from 2 standard stock arrangements was pipetted out and make up to 10 ml (60 µg/ ml Telmisartan and 12 µg/ml Azelnidipine).

The respective concentrations of Azelnidipine 2-12 µg/ml and Telmisartan 10-60 µg/ml were injected 6 times at different linear dose, the results are shown in Table 5, linearity equations for Azelnidipine and Telmisartan were y= 18693 x+538.6 and y=18974x+2744, respectively. The Calibration curve is shown in Figures 10 and 11. The correlation coefficient for two drugs was 0.999.

Robustness:

Samples were injected in duplicate under robustness settings that included Flow - (0.9 ml/min), Flow + (1.1 ml/min), Mobile Phase - , Mobile phase +, Temperature -25°C, and Temperature +35°C. All of the system suitability parameters passed with little to no impact. Percentage (%) RSD was not over the upper bound, the values obtained by robustness are given in Table 7.

Sensitivity:

The LOD and LOQ of Azelnidipine and Telmisartan are shown in Table 7 and Chromatogram showing LOD and LOQ is shown in Figures 12 and 13.

Assay:

40 mg of Telmisartan and 8 mg of Azelnidipine was used for the assay. Telmisartan and azelnidipine yielded average assay percentages of 100.59% and 99.63%, respectively. The assay values are given Table 8.

Degradation Research:

The percentage of drug degradation in solution is determined by pumping standards and degraded samples, and applying different methodologies such as acidic, alkaline, photolytic, Thermal, Oxidative and Nutral Analysis. The values obtained by degradation studies are given in Table 9.

Table 7: Azelnidipine and Telmisartan sensitivity table

Molecule	LOD	LOQ
AZELNIDIPINE	00.06	00.18
TELMISARTAN	00.36	1.09

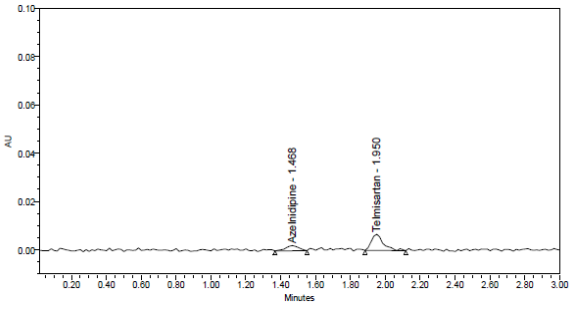

Fig. 12: Chromatogram showing LOD of Azelnidipine and Telmisartan.

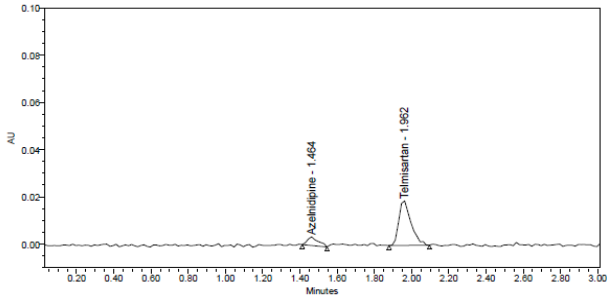

Fig. 13: Chromatogram of LOQ of Azelnidipine and Telmisartan.

Table 8: Azelnidipine and Telmisartan Assay Data

	Azelnidipine			**Telmisartan**		
S. No.	**STANDARD AREA**	**SAMPLE AREA**	**% ASSAY**	**STANDARD AREA**	**SAMPLE AREA**	**% ASSAY**
1	149589	148682	100.33	743479	745037	99.69
2	147575	149572	100.93	753688	739059	98.89
3	148582	147901	99.81	746006	748068	100.09
4	141377	148931	100.50	742070	742337	99.32
5	149618	149230	100.70	744335	745778	99.78
6	151501	150041	101.25	750270	747680	100.04
Avg	148040	149060	100.59	746641	744660	99.63
Stdev	3514.9	742.5	0.50	4459.7	3432.0	0.46
%RSD	2.4	0.5	0.5	0.6	0.5	0.46

Table 9: Data of Degradation Studies

Type of degradation	Azelnidipine			Telmisartan		
	AREA	% RECOVERED	% DEGRADED	AREA	% RECOVERED	% DEGRADED
Acid	141852	094.76	5.24	704581	094.27	05.73
Base	143150	095.63	4.37	711146	095.15	04.85
Peroxide	143274	095.71	4.29	710068	095.01	4.99
Thermal	145734	097.36	2.64	729662	097.63	2.37
Uv	146759	098.04	1.96	737571	098.69	1.31
Water	148528	099.22	0.78	743631	099.50	0.50

Table 10: Overview of results

PARAMETERS		AZELNIDIPINE	TELMISARTAN	LIMIT
Linearity Range (µg/ml)		2-12µg/ml.	10-60µg/ml.	R<1.
Regression Coefficient		00.9997	0.9997	
Slope (m)		18693	18974	
Intercept (c)		538.62	2744.9	
Regression Equation (Y=mx+c)		Y =18693x + 538.62	Y=18974x+2744.9	
ASSAY(%Mean Assay)		100.59	099.63	090-110%
Specificity		specific	Specific	No Interference of any Peak
System, precision %RSD		2.4	00.6	NMT 2.0%
Method precision %RSD		00.5	0.5	NMT 2.0%
Accuracy % (per cent) Recovery		100.77	100.09	98-102%
LOD µg/ml		00.06	00.36	NMT 3.
LOQ µg/ml		00.18	0.09	NMT10
Robustnes	**FM**	00.7	1.0	Per cent (%) RSD NMT 2.00
	FP	1	0.7	
	MM	0.9	1.1	
	MP	01.2	00.3	
	TM	00.8	00.8	
	TP	00.4	00.4	

Overview of Results: Table 10 illustrates the overview of results.

Azelnidipine and Telmisartan dose forms were simultaneously estimated using a straight forward, accurate, and precise procedure. Telmisartan and Azelnidipine were shown to have retention times of 1.962 and 1.468 min, respectively. Temisartan's and azelnidipine's percentage RSDs were discovered to be 2.4 and 0.6, respectively. %Recovery was obtained as 100.59% and 99.63% for Azelnidipine and Telmisartan, respectively. LOD and LOQ values derived from the waning formulas of Azelnidipine and Telmisartan were 0.06 and 0.18; and 0.36 and 1.09, respectively. Regression equation of y = 18693x + 538.62 of Azelnidipine and Telmisartan is y = 18974x + 2744.9.

Conclusion

Stability indicating UPLC method for simultaneous estimation of Telmisetan and Azelnidipine in dosage form in their degradation studies. This

method of analysis time is very short accurate, specific, sensitive, selective, and robustness proved by validation results. The degradation studies of Telmisertan and Azlinidipine under different methodologies like acid, alkaline, oxidative, photolytic, thermal, and neutral analysis, peaks are well separated.

References

Balt JC, Mathy MJ, Nap A, Pfaffendorf M and van Zwieten PA. (2001) Effect of the AT1- receptor antagonists losartan, irbesartan, and telmisartan on angiotensin II-induced facilitation of sympathetic neurotrans-mission in the rat mesenteric artery. J Cardiovasc Pharmacol. 38(1):141-8.

Jain PS, Chaudhari AJ, Patel SA, Patel ZN and Patel DT. (2011) Development and validation of the UV-spectrophotometric method for determination of terbinafine hydrochloride in bulk and in formulation. Pharm Methods 2(3): 198-202.

Karlberg BE, Lins LE and Hermansson K. (1999) Efficacy and safety of telmisartan, a selective AT1 receptor antagonist, compared with Enalapril in elderly patients with primary hypertension. TEES Study Group. J Hypertens. 17(2): 293-302.

Koike H. (2002) Azelnidipine, a long-acting calcium channel blocker with slow onset and high vascular affinity. Annu Rep Sankyo Res Lab. 54: 1-64.

Korolkovas A. (1988) Essentials of Medicinal Chemistry. 2nd edn., Wiley Interscience, New Jersey.

Mukhopadhyay S, Kadam K, Sawant L, Nachane D and Pandita N. (2011) Simultaneous determination of related substances of telmisartan and hydrochlorothiazide in tablet dosage form by using reversed phase high performance liquid chromatographic method. J Pharm Bioallied Sci. 3(3): 375-383.

Patel JK and Patel NK. (2014) Validated stability-indicating RP-HPLC method for the simultaneous determination of azelnidipine and olmesartan in their combined dosage form. Sci Pharm. 82: 541-554.

Ram CV. (20130 Fixed-dose triple-combination treatment s in the management of hypertension. Managed Care (Langhorne, Pa.) 22(12): 45-55.

Reema HR and Joshi HS. (2013) Stability indicating simultaneous validation of telmisartan and cilnidipine with forced degradation behavior study by RP HPLC in tablet dosage form. Int Scholarly Research Notices 2013: 461461.

Rele RV. (2014) Spectrophotometric estimation of azelnidipine in bulk and pharmaceutical dosage form by second order derivative method. J Chem Pharmaceut Res. 6: 198-202.

Rowan CG, Turner JR, Shah A and Spaeder JA. (2014) Anti-hypertensive treatment and blood pressure control relative to hypertension treatment guidelines. Pharmacoepidemiol Drug Safety 23(12): 1294-1302.

Santosh KM and Venkateshwar RJ. (2014) Development and validation of a stability indicating RP-HPLC method for simultaneous determination of telmisartan and amlodipine in combined dosage form. Asian J Pharm Clin Res. 7(1): 32-35

Wan X, Ma P and Zhang X. (2014) A promising choice in hypertension treatment: Fixed-dose combinations. Asian J Pharmaceut Sci. 9(1): 1-7.

Wankhede SB and Tajne MR. (2007) RP-HPLC method for simultaneous estimation of telmisartan and hydrochlorothiazide in tablet dosage form. Indian J Pharm Sci. 69(2): 298-300