International Journal of Current Trends in Pharmaceutical Research
Home Page: https://pharmaresearchlibrary.org/journals/index.php/ijctpr
CODEN (USA): IJCTGM | ISSN: 2321-3760 | Publisher: Pharma Research Library
Int. J. Curnt. Tren. Pharm, Res., 2025, 13(2): 117-125
DOI: https://doi.org/10.30904/j.ijctpr.2025.4893

QBD Driven Analytical Method Development and Validation for Sotagliflozin in bulk and Pharmaceutical Dosage Form by RP- HPLC

Durgam Ishwarya*[1], P. Aravinda Reddy[2]
[1]Department of Pharmaceutical Analysis, Mother Teresa College of Pharmacy, NFC Nagar Ghatkesar, Telangana India-501301.
[2]Principal and Professor, Mother Teresa College of Pharmacy, NFC Nagar Ghatkesar, Telangana India-501301.

A B S T R A C T

A simple, sensitive, and precise reverse-phase high-performance liquid chromatography (RP-HPLC) method was developed and validated for the quantitative estimation of Sotagliflozin in bulk and pharmaceutical dosage forms, following ICH Q2(R1) guidelines. Chromatographic separation was achieved using an Inspire C18 column (3.0 × 150 mm, 5 µm) with a mobile phase comprising phosphate buffer (pH 5.8) and methanol in a 70:30 v/v ratio at a flow rate of 1.0 mL/min. Detection was performed at 221 nm using a PDA detector, with an injection volume of 10 µL and a run time of 20 minutes. The method demonstrated excellent linearity in the range of 10–50 µg/mL, with a correlation coefficient (R^2) of 0.9996. System suitability parameters, including a USP plate count of 7801.77 and a tailing factor of 1.02, complied with acceptance criteria. Precision studies showed %RSD values of 0.11% (repeatability) and 0.12% (intermediate precision), indicating high reproducibility. Accuracy results yielded a mean recovery of 100.3%, confirming method reliability. The limits of detection (LOD) and quantification (LOQ) were found to be 0.03 µg/mL and 0.09 µg/mL, respectively. Robustness testing demonstrated that deliberate variations in flow rate and mobile phase composition did not significantly affect chromatographic performance. This validated RP-HPLC method is reliable, rapid, and cost-effective, making it suitable for routine quality control and regulatory compliance testing of Sotagliflozin in pharmaceutical formulations.

Keywords: Dual SGLT1/SGLT2 Inhibitor Analysis, RP-HPLC Method Development, Validation, Inspire C18 Column Chromatography,Phosphate Buffer–Methanol Mobile Phase (pH 5.8), Sensitivity with Low LOD, LOQ, Precision, Accuracy in Antidiabetic Drug Assay

A R T I C L E I N F O

Corresponding Author
Durgam Ishwarya
Department of Pharmaceutical Analysis
Mother Teresa College of Pharmacy
NFC Nagar Ghatkesar, Telangana India- 501301.

Article History
Received : 28 July 2025
Revised : 10 Aug 2025
Accepted : 11 Sep 2025
Published : 25 Oct 2025

Citation: Durgam Ishwarya and P. Aravinda Reddy. QBD Driven Analytical Method Development and Validation for Sotagliflozin in bulk and Pharmaceutical Dosage Form by RP- HPLC. Int. J. Curnt. Tren. Pharm, Res., 2025; 13(2): 117-125.

C O N T E N T S

1. Introduction

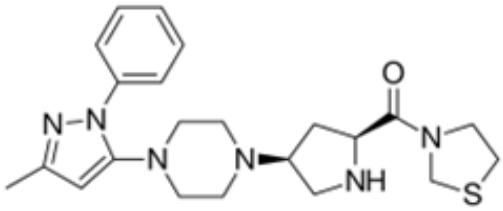

Fig.1: Sotagliflozin

Table 2: Rosuvastatin Calcium

S.N	Materials	Source
1	Molecular Formula	C38H50N6O5
2	Molecular weight	670.86 g/mol
3	IUPAC Name	(2S)-N-[(2S,3R)-4-[(3S)-3-(tert-butylcarbamoyl)-3-pyridin-2-ylpropyl]-3-hydroxy-1-

		phenylbutan-2-yl]-2-(quinolin-2ylcarbonylamino)butanediamide
4	ChemSpider ID	4449
5	Density	1.23 g/cm3
6	Boiling Point	720.4°C
7	Vapour Pressure	1.15E-13 mmHg
8	Flash Point	386.4°C
	Refractive Index	1.56
	Polar surface area	173.2 Å2
	LogP	4.7 (Octanol/Water)
	Generic Name	Sotagliflozin
	Brand Names	Invirase, Fortovase
	Drug category	HIV Protease Inhibitor
	Indications	Treatment of HIV-1 infection in combination with other antiretroviral agents
	Pharmacology	Inhibition of HIV-1 protease, preventing viral replication
	Potency	High potency against HIV-1 protease
	Tolerability	Generally well-tolerated, but may cause gastrointestinal disturbances, diarrhea, and nausea
	Contraindications	Hypersensitivity to Sotagliflozin or any component of the formulation
	Adverse Effects	Gastrointestinal disturbances, diarrhea, nausea, vomiting, abdominal pain
	Availability	Prescription-only medication, available in oral capsules or tablets
	Mechanism of Action	1. Binding to HIV Protease: Sotagliflozin binds to the active site of the HIV protease enzyme, which is essential for the maturation of viral particles. 2. Inhibition of Proteolytic Cleavage: By binding to the active site, saquinavir prevents the protease enzyme from cleaving viral polyprotein precursors into functional proteins, such as gag, pol, and env. 3.Prevention of Viral Maturation: The inhibition of proteolytic cleavage prevents the maturation of viral particles, thereby inhibiting the replication of HIV. 4. Reduction of Viral Load: The reduction in viral replication leads to a decrease in viral load, which slows down the progression of HIV disease.

2. Materils and Methods

Table 3: List of Equipment's used

S.N	Instrument	Model
1	Instrument	WATERS, software: Empower, 2695 separation module, PDA detector.
2	HPLC	LABINDIA UV 3000+
3	UV/VIS spectrophotometer	Thermo – Orion Star A111
4	pH meter	SCALETEC-Model SAB-203L
5	Weighing machine	Borosil
6	Pipettes & Burettes	Borosil

Table 4: List of Materials Used

S.N	Chemical	Company Name
1	Sotagliflozin	Glenmark
2	KH_2PO_4	FINER chemical LTD
3	Water and Methanol for HPLC	LICHROSOLV (MERCK)
4	Acetonitrile for HPLC	MOLYCHEM
5	Ortho phosphoric Acid	MERCK

Hplc method Development:

Wave length selection: UV spectrum of 10 µg / ml each drug of Sotagliflozin in diluent (mobile phase composition) was recorded by scanning in the range of 200nm to 400nm. From the UV spectrum wavelength selected as 221nm. At this wavelength both the drugs show good absorbance.

Mobile Phase Optimization:

Initially the mobile phase tried was methanol: Ortho phosphoric acid buffer and Methanol: phosphate buffer, Acetonitrile: methanol with various combinations of pH as well as varying proportions. Finally, the mobile phase was optimized to pH 5.8 Phosphate buffer and methanol in proportion gradient programme.

Optimization of Column:

The method was performed with various columns like C18 column Phenomenex column, YMC, and Inertsil ODS column. Platsil (4.6*250mm, 5µ) was found to be ideal as it gave good peak shape and resolution at 1.0 ml/min flow.

Optimized chromatographic conditions:

Equipment : High performance liquid chromatography equipped with Auto Sampler and PDA detector
Column : Inspire (3.0*150mm, 5µ)
Buffer : pH 5.8 Phosphate buffer
Mobile phase : pH 5.8 Phosphate buffer 70: Methanol 30 (Gradient)
Flow rate : 1.0 ml per min
Wavelength : 221 nm
Injection volume : 10 µl
Run time : 20 min.

Preparation of buffer and mobile phase:

Preparation of pH 5.8 Phosphate buffer: 6.8 g of kH2PO4 is taken into 1000 ml of HPLC water and adjust the to pH 5.8 with NaoH solution ,then filtered through 0.45 µm Membrane filter and sonicate it for 5 mins.

Diluent Preparation: The Mobile phase was used as the diluent.

Preparation of standard solution:

Standard Solution Preparation: Accurately weigh and transfer 25 mg of Sotagliflozin working standard and spike 1mg of impurity-A and 1mg of impurity-b into a 25 ml clean dry volumetric flask add about 10 mL of Diluent and sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution)**.** Further pipette 0.3 ml of the above stock solutions into a 10ml volumetric flask and dilute up to the mark with diluent.

Procedure: Inject 20 µL of the standard, sample into the chromatographic system and measure the area for Sotagliflozin peak and calculate the %Assay by using the formulae.

System suitability: Tailing factor for the peak due to Sotagliflozin in Standard solution should not be more than 2.0**.** Theoretical plates for the Sotagliflozin peak in Standard solution should not be less than 2000. Resolution for the Sotagliflozin peak in standard solution should not be less than 2.

Calculation: (For Sotagliflozin)

$$\%\ Assay = \frac{AT}{AS} * \frac{WS}{DS} * \frac{DT}{WT} * \frac{Average\ weight}{Label\ Claim} * \frac{P}{100} * 100$$

Where:

AT = average area counts of sample preparation.

AS = average area counts of standard preparation.

WS = Weight of working standard taken in mg.

P = Percentage purity of working standard

LC = Label Claim mg/ml.

Sample and Standard Details

S.No	Samples
1	Sotagliflozin
2	Sotagliflozin working standard

Method validation summary:

Precision:

Preparation of stock solution: Accurately weigh and transfer 25 mg of Sotagliflozin working standard into a 25 ml clean dry volumetric flask add about 10 mL of Diluent and sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution). Further pipette 0.3 ml of the above stock solutions into a 10ml volumetric flask and dilute up to the mark with diluent.

Procedure:

The standard solution was injected for six times and measured the area for all six Injections in HPLC. The %RSD for the area of six replicate injections was found to be within the specified limits.

Intermediate precision/ruggedness:

To evaluate the intermediate precision (also known as Ruggedness) of the method, Precision was performed on different day.

Preparation of stock solution:

Accurately weigh and transfer 25 mg of Sotagliflozin working standard into a 25 ml clean dry volumetric flask add about 10 mL of Diluent and sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution). Further pipette 0.3 ml of the above stock solutions into 10ml volumetric flask and dilute up to the mark with diluent.

Procedure: The standard solution prepared in the precision was injected on the other day, for six times and measured the area for all six injections in HPLC. The %RSD for the area of six replicate injections was found to be within the specified limits.

Accuracy:

Preparation of Standard stock solution:

Accurately weigh and transfer 25 mg of Sotagliflozin working standard into a 25 ml clean dry volumetric flask add about 10 mL of Diluent and sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution). Further pipette 0.3 ml of the above stock solutions into a 10ml volumetric flask and dilute up to the mark with diluent.

Preparation Sample solutions:

For preparation of 50% solution (With respect to target Assay concentration): Accurately weigh and transfer 12.5 mg of Sotagliflozin working standard into a 25 ml clean dry volumetric flask add about 10 mL of Diluent and sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution). Further pipette 0.3 ml of the above stock solutions into a 10ml volumetric flask and dilute up to the mark with diluent.

For preparation of 100% solution (With respect to target Assay concentration): Accurately weigh and transfer 25 mg of Sotagliflozin working standard into a 25 ml clean dry volumetric flask add about 10 mL of Diluent and sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution). Further pipette 0.3 ml of the above stock solutions into a 10ml volumetric flask and dilute up to the mark with diluent.

For preparation of 150% solution (With respect to target Assay concentration): Accurately weigh and transfer 37.5 mg of Sotagliflozin working standard into a 25 ml clean dry volumetric flask add about 10 mL of Diluent and sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution)**.** Further pipette 0.3 ml of the above stock solutions into a 10ml volumetric flask and dilute up to the mark with diluent.

Procedure:

Inject the standard solution, Accuracy -50%, Accuracy -100% and Accuracy -150% solutions.

Calculate the Amount found and Amount added for Sotagliflozin and calculate the individual recovery and mean recovery values.

Linearity:

Preparation of stock solution:

Accurately weigh and transfer 25 mg of Sotagliflozin working standard into a 25 ml clean dry volumetric flask add about 10 mL of Diluent and sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution)

Preparation of Level – I

0.1 ml of above stock solutions has taken in different 10ml of volumetric flasks, dilute up to the mark with diluent.

Preparation of Level – II

0.2 ml of above stock solutions has taken in different 10ml of volumetric flasks, dilute up to the mark with diluent.

Preparation of Level – III:

0.3ml of above stock solutions has taken in different 10ml of volumetric flasks, dilute up to the mark with diluent.

Preparation of Level – IV:

0.4 ml of above stock solutions has taken in different 10ml of volumetric flasks, dilute up to the mark with diluent

Preparation of Level – V:

0.5 ml of above stock solutions has taken in different 10ml of volumetric flasks, dilute up to the mark with diluent

Procedure:

Inject each level into the chromatographic system and measure the peak area.

Plot a graph of peak area versus concentration (on X-axis concentration and on Y-axis Peak area) and calculate the correlation coefficient.

Detection limit

Limit of detection:

Preparation of 0.02 µg/ml solution:

Accurately weigh and transfer 25 mg of Sotagliflozin working standard into a 25 ml clean dry volumetric flask add about 10 mL of Diluent and sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution). Further pipette 0.3 ml of the above stock solutions into a 10ml volumetric flask and dilute up to the mark with diluents. Further pipette 0.1ml of the above stock solutions into a 10ml volumetric flask and dilute up to the mark with diluents. Further pipette 0.24 ml of the above stock solutions into a 10ml volumetric flask and dilute up to the mark with diluent.

Acceptance Criteria:

S/N Ratio value shall be 3 for LOD solution.

Limit of quantification:

Preparation of 0.02µg/ml solution:

Accurately weigh and transfer 25 mg of Sotagliflozin working standard into a 25 ml clean dry volumetric flask add about 10 mL of Diluent and sonicate to dissolve it completely and make volume up to the mark with the same solvent. (Stock solution). Further pipette 0.3 ml of the above stock solutions into a 10ml volumetric flask and dilute up to the mark with diluents. Further pipette 0.1 ml of the above stock solutions into a 10ml volumetric flask and dilute up to the mark with diluents. Further pipette 0.8 ml of the above stock solutions into a 10ml volumetric flask and dilute up to the mark with diluent.

Acceptance Criteria:

S/N Ratio value shall be 10 for LOQ solution.

Procedure for LOD and LOQ:

The LOD and LOQ solutions was prepared injected, for three times and measured the area for all three injections in HPLC. The %RSD for the area of six replicate injections was found to be within the specified limits.

Robustness:

As part of the Robustness, deliberate change in the Flow rate, Mobile Phase composition, Temperature Variation was made to evaluate the impact on the method.

A. The flow rate was varied at 0.8 ml/min to 1.2ml/min. Standard solution 30 ppm of Sotagliflozin was prepared and analysed using the varied flow rates along with method flow rate. On evaluation of the above results, it can be concluded that the variation in flow rate affected the method significantly. Hence it indicates that the method is robust even by change in the flow rate ±10%.

B. The Organic composition in the Mobile phase was varied from 63% to 77%: Standard solution 30 ppm of Sotagliflozin was prepared and analysed using the varied Mobile phase composition along with the actual mobile phase composition in the method. On evaluation of the above results, it can be concluded that the variation in 10%. Organic composition in the mobile phase affected the method significantly. Hence it indicates that the method is robust even by change in the Mobile phase ±10.

3. Results and Discussion

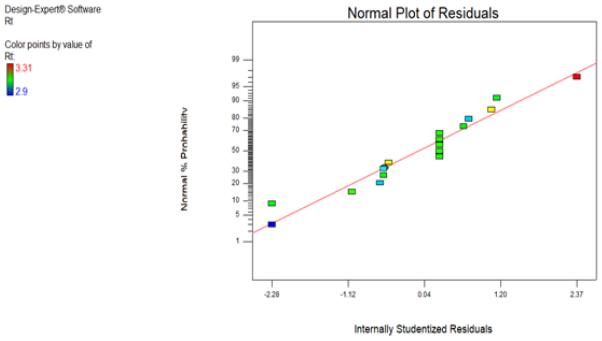

Fig.2: Normal plot of Residuals for Sotagliflozin

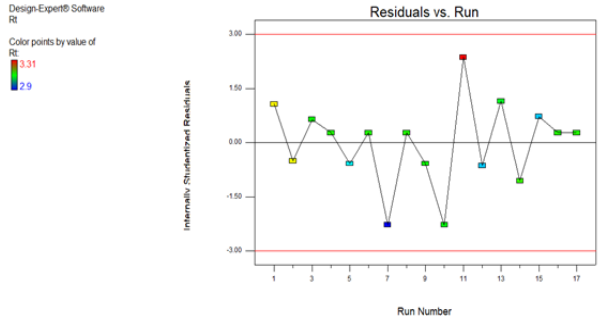

Fig.3: Residuals vs. Run for Sotagliflozin

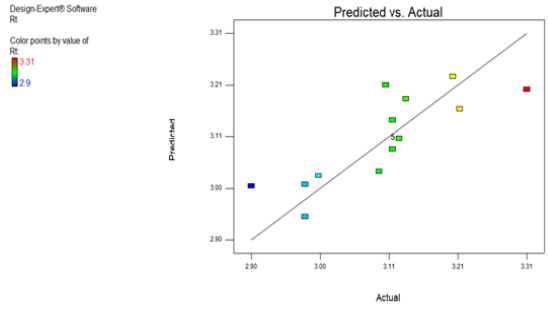

Fig.4: Predicted vs. Actual for Sotagliflozin

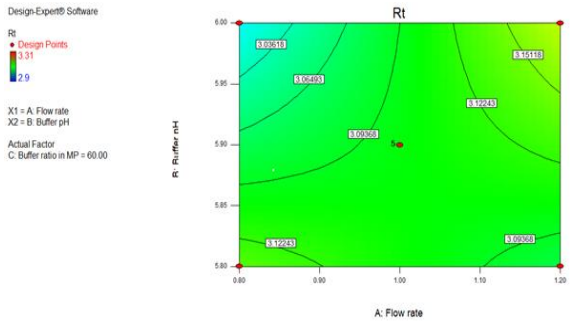

Fig.5: Retention time for Sotagliflozin

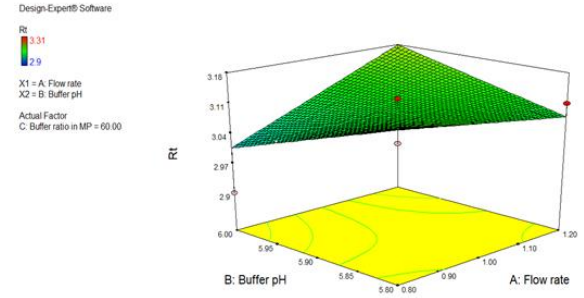

Fig.6: 3D Surface for Sotagliflozin

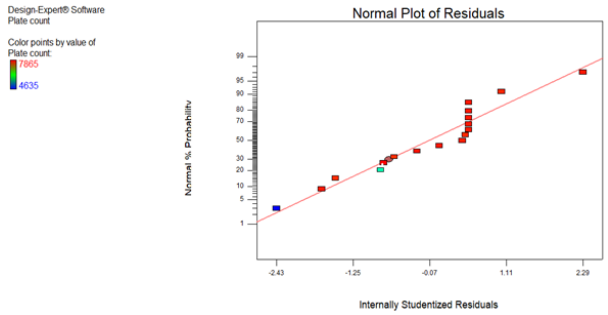

Fig.7: Normal plot of Residuals for Sotagliflozin

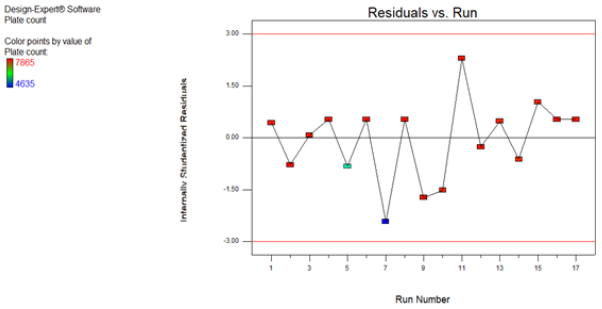

Fig.8: Residuals vs. Run for Sotagliflozin

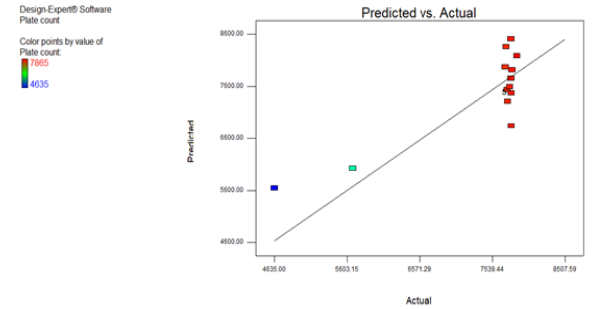

Fig.9: Predicted vs. Actual for Sotagliflozin

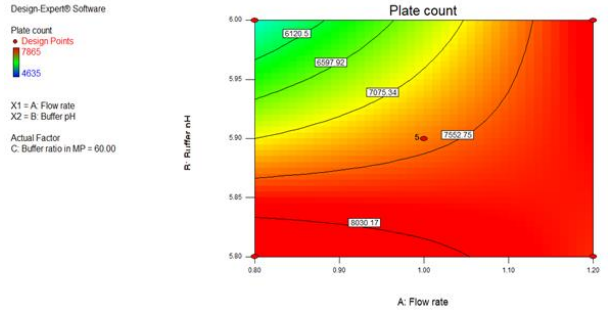

Fig.10: Plate count for Sotagliflozin

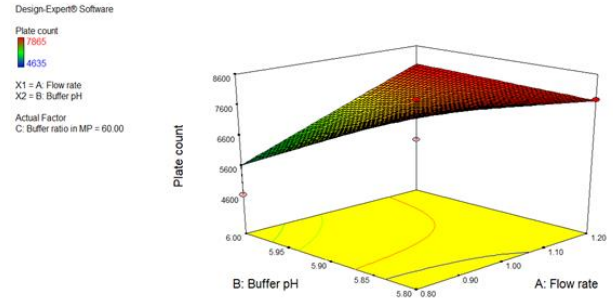

Fig.11: 3D Surface for Sotagliflozin

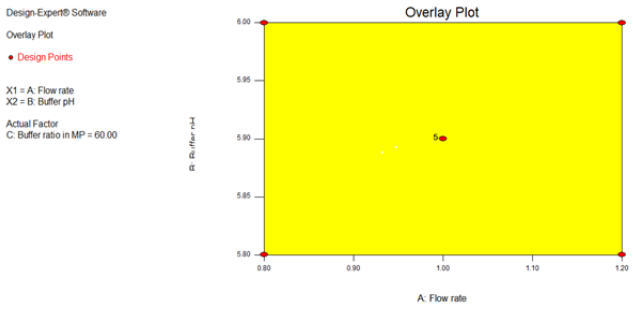

Fig.12: Overlay plot for Sotagliflozin

Optimized chromatographic conditions:
Equipment : High performance liquid chromatography equipped with auto Sampler and PDA detector
Column : Inspire (3.0*150mm, 5µ)
Buffer : pH 5.8 Phosphate buffer
Mobile phase : pH 5.8 Phosphate buffer 70: Methanol 30
Flow rate : 1.0 ml per min
Wavelength : 221 nm
Injection volume : 10 µl
Run time : 20 min.

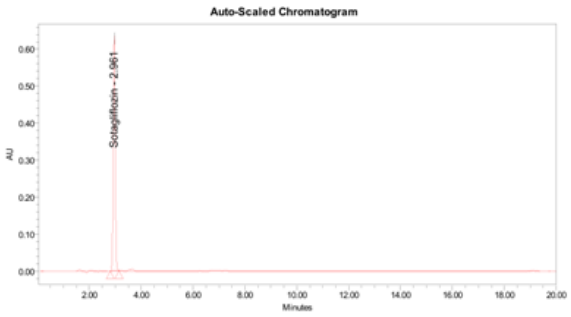

Fig.13: Optimized Chromatogram

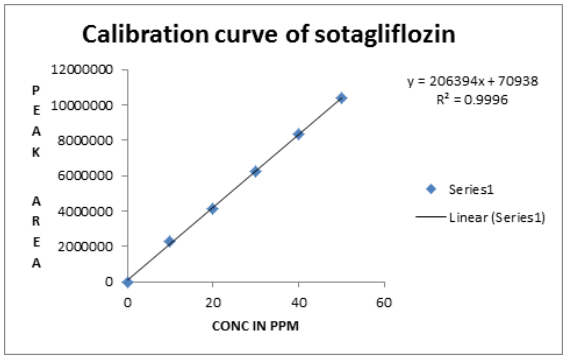

Fig.14: Linearity Graph of Sotagliflozin

Table 5: Linearity results

S.N	Linearity Level	Concentration (µg/ml)	Area
1	I	10	**2275836**
2	II	20	**4151410**
3	III	30	**6226542**
4	IV	40	**8332145**
5	V	50	**10398746**
Correlation Coefficient			0.9996

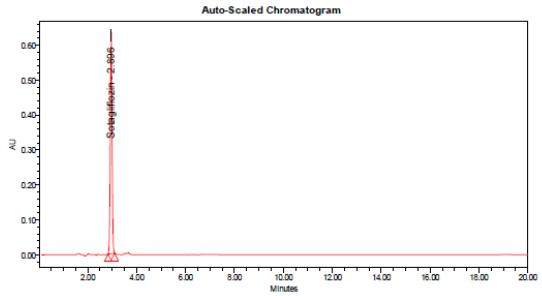

Fig.15: Chromatogram For Precision-6

Table 6: The results are summarized for Sotagliflozin

Injection	**Areas**
Injection-1	6239874
Injection-2	6232589
Injection-3	6224542
Injection-4	6233217
Injection-5	6223698
Injection-6	6238741
Average	6232110.167
Standard Deviation	6837.267215
%RSD	0.11

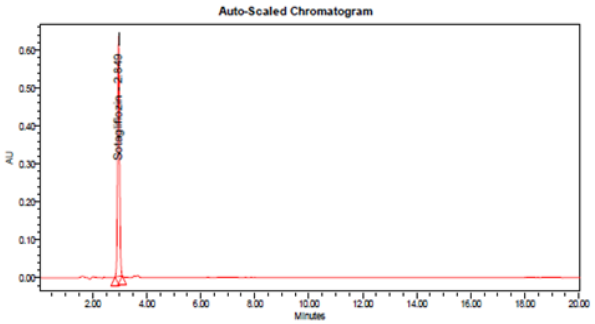

Fig.16: Chromatogram For Id Precision -6

Table 7: ID Precision Result

Injection	**Areas**
Injection-1	**6246541**
Injection-2	**6233698**
Injection-3	**6249874**
Injection-4	**6233214**
Injection-5	**6249254**
Injection-6	**6245684**
Average	**6243044.167**
Standard Deviation	**7594.579973**
%RSD	**0.12**

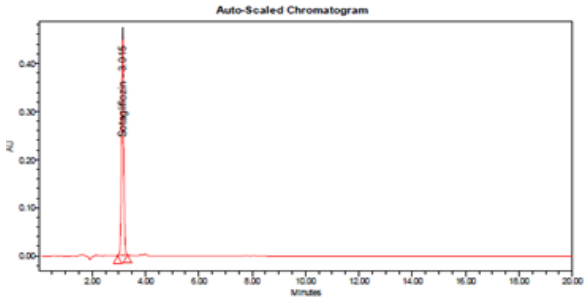

Fig.17: Chromatogram for Accuracy 50%-3

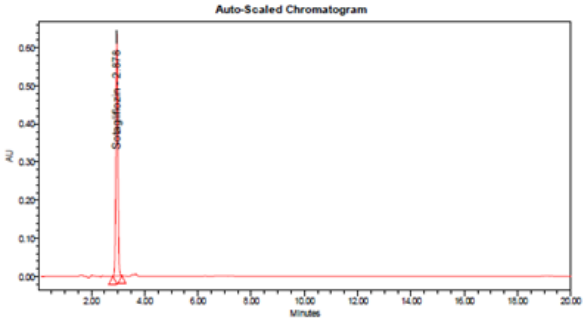

Fig.18: Chromatogram for Accuracy 100%-3

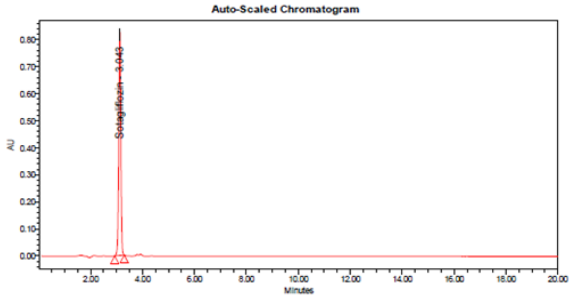

Fig.19: Chromatogram For Accuracy 150%-3

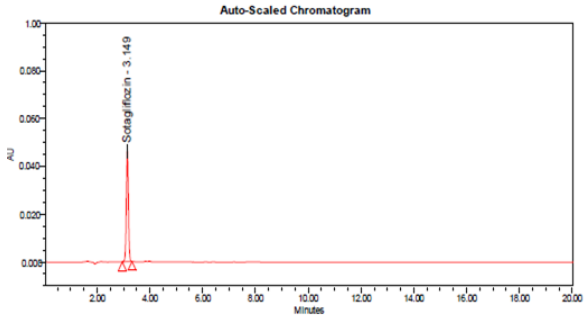

Fig.20: Chromatogram of Sotagliflozin Showing LOQ

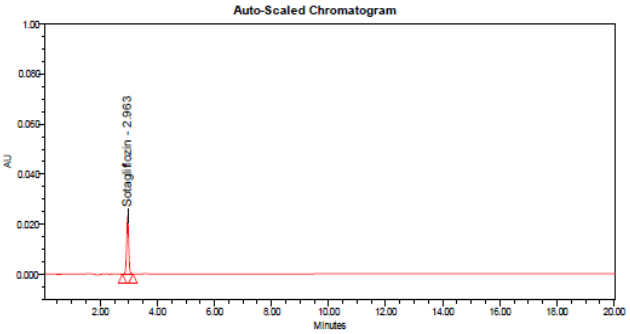

Fig.21: Chromatogram of Sotagliflozin Showing LOD

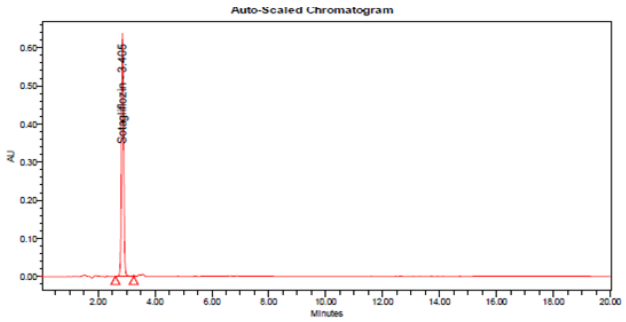

Fig.22: Chromatogram Showing Less Flow

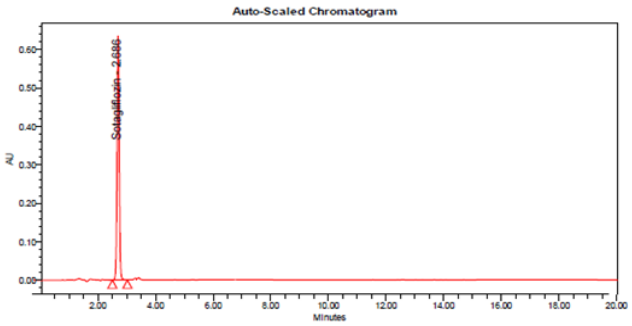

Fig.23: Chromatogram Showing More Flow

Response-1 Retention Time of Sotagliflozin Table 8: FIT Summary

Source	Sum of squares	df	Mean square	F value	P-value Prob>F	
Mean vs. Total	163.49	1	163.49			Suggested
Linear vs. Mean	9.175E-003	3	3.058E-003	0.29	0.8346	
2FI vs. Linear	0.089	3	0.030	5.91	0.0138	Suggested
Quadratic vs. 2FI	0.019	3	6.242E-003	1.39	0.3229	
Cubic vs Quadratic	0.031	3	0.010	6.366E+007	< 0.0001	Aliased
Residual	0.000	4	0.000			
Total	163.64	17	9.63			

ANOVA for Quadratic model: Table 9: Response: 1 RT

Source	Sum of squares	df	Mean square	F value	p-value prob>f	
Model	0.098	6	0.016	3.26	0.0483	significant
A-Flow rate	6.613E-003	1	6.613E-003	1.32	0.2776	
B-Buffer pH	4.500E-004	1	4.500E-004	0.090	0.7707	
C-Buffer ratio in MP	2.113E-003	1	2.113E-003	0.42	0.5309	
AB	0.013	1	0.013	2.64	0.1355	
AC	0.048	1	0.048	9.65	0.0111	
BC	0.027	1	0.027	5.43	0.0421	
Residual	0.050	10	5.015E-003			
Lack of Fit	0.050	6	8.359E-003			
Pure Error	0.000	4	0.000			
Cor Total	0.15	16				

ANOVA for Quadratic model Table 10: Response 2: tailing factor

source	Sum of squares	df	Mean square	F value	P value Prob>F	
Model	8.775E+006	6	1.462E+006	3.74	0.0323	significant
A-Flow rate	1.237E+006	1	1.237E+006	3.17	0.1055	
B-Buffer pH	3.517E+006	1	3.517E+006	9.00	0.0133	
C-Buffer ratio in MP	6.351E+005	1	6.351E+005	1.63	0.2311	
AB	2.367E+006	1	2.367E+006	6.06	0.0336	
AC	8010.25	1	8010.25	0.021	0.8890	
BC	1.011E+006	1	1.011E+006	2.59	0.1387	
Residual	3.906E+006	10	3.906E+005			
Lack of Fit	3.906E+006	6	6.510E+005			
Pure Error	0.000	4	0.000			
Cor Total	1.268E+007	16				

Table 11: The Accuracy Results

%Concentration (at specification Level)	Area	Amount Added (mg)	Amount Found(mg)	% Recovery	Mean Recovery
50%	3158526	12.5	12.7	101.3	100.3
100%	6204815	25	24.9	99.5	
150%	9371658	37.5	37.6	100.1	

Table 12: The Accuracy Results

%Concentration (at specification Level)	Area	Amount Added (mg)	Amount Found(mg)	% Recovery	Mean Recovery
50%	3158526	12.5	12.7	101.3	100.3
100%	6204815	25	24.9	99.5	
150%	9371658	37.5	37.6	100.1	

Table 13: Robustness flow rate studies

S. No	Flow Rate (ml/min)	System Suitability Results	
		USP Plate Count	USP Tailing
1	0.8	6821.43	0.98
2	1.0	6824.48	1.00
3	1.2	6826.50	0.99

Table 14: Robustness Change in Organic Composition

S. No	Change in Organic Composition in the Mobile Phase	System Suitability Results	
		USP Plate Count	USP Tailing
1	10% less	6822.42	0.97
2	*Actual	6824.48	1.00
3	10% more	6826.51	0.98

4. Conclusion

The method demonstrated excellent linearity in the range of 10–50 µg/mL, with a correlation coefficient (R^2) of 0.9996. System suitability parameters, including a USP plate count of 7801.77 and a tailing factor of 1.02, complied with acceptance criteria. Precision studies showed %RSD values of 0.11% (repeatability) and 0.12% (intermediate precision), indicating high reproducibility. Accuracy results yielded a mean recovery of 100.3%, confirming method reliability. The limits of detection (LOD) and quantification (LOQ) were found to be 0.03 µg/mL and 0.09 µg/mL, respectively. Robustness testing demonstrated that deliberate variations in flow rate and mobile phase composition did not significantly affect chromatographic performance. This validated RP-HPLC method is reliable, rapid, and cost-effective, making it suitable for routine quality control and regulatory compliance testing of Sotagliflozin in pharmaceutical formulations.

5. References

[1] Zhao MM, Zhang H, Iimura S, Bednarz MS, Song QL, Lim NK, Yan J, Wu W, Dai K, Gu X, Wang Y. Process development of sotagliflozin, a dual inhibitor of sodium–glucose cotransporter-1/2 for the treatment of diabetes. Organic Process Research & Development. 2020 Oct 7;24(11): 2689-701.

[2] Aligi A, Kishore K, Gampa VK. Formulation and Assessment of Solid Dosage Form of sotagliflozin with Controlled Release. World Journal of Pharmacy and Biotechnology. 2025 Jan 12;12(1):01-9.

[3] He X, Gao X, Xie P, Liu Y, Bai W, Liu Y, Shi A. Pharmacokinetics, pharmacodynamics, safety and tolerability of sotagliflozin after multiple ascending doses in chinese healthy subjects. Drug Design, Development and Therapy. 2022 Jan 1:2967-80.

[4] Xin Y, Zhou S, Wang H, Hu B, Zhang Z, Wang J, Sun T. Comprehensive structure–activity relationship (SAR) investigation of C-aryl glycoside derivatives for the development of SGLT1/SGLT2 dual inhibitors. New Journal of Chemistry. 2021;45(31):14193-210.

[5] Deshmukh NJ, Kalshetti MS, Patil M, Nandanwar M, Sangle GV. Therapeutic Potential of Sotagliflozin in Animal Models of Non-alcoholic Fatty Liver Disease with and without Diabetes. Drug Research. 2025 Apr 14.

[6] Wu C, Huo X, Liu J, Zhang L, Bai X, Hu S, Li X, Lu J, Zheng X, Li J, Zhang H. Development and validation of a risk prediction model for in-hospital major cardiovascular events in patients hospitalised for acute myocardial infarction. BMJ open. 2021 May 1;11(5):e042506.

[7] Bantounou MA, Sardellis P, Thuemmler R, Black Boada D, Kaczmarek J, Mahmood R, Plascevic J, Philip S. Effect of the dual sodium-glucose co-transporter-1 and-2 inhibitor sotagliflozin on renal outcomes in type 1 diabetes and type 2 diabetes: A systematic review and meta-analysis of randomized controlled trials. Diabetes, Obesity and Metabolism. 2024 Feb;26(2):710-20.

[8] Chawla G, Chaudhary KK. A complete review of empagliflozin: Most specific and potent SGLT2 inhibitor used for the treatment of type 2 diabetes mellitus. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. May 1;13(3):2001-8.

[9] Deshmukh NJ, Kalshetti MS, Patil M, Autade P, Sangle GV. Exploring the modulatory effects of sotagliflozin on dyslipidemia in mice: the role of glucagon, fibroblast growth factor 21 and glucagon-like peptide 1. Clinical and Experimental Pharmacology and Physiology. 2024 May;51(5): e13854.

[10] TAICHMAN R, Smolyak J, Bedi K, Patel S, Margulies K, Day S, Lee B. Sotagliflozin Reduces Contractile Work In Human Living Myocardial Slices. Circulation. 2024, 12; 150(1): A4144253

[11] Iyer N, Hussein S, Singareddy S, Sn VP, Jaramillo AP, Yasir M, Nath TS. Sotagliflozin vs dapagliflozin: a systematic review comparing cardiovascular mortality. Cureus. 2023 Sep 19;15(9)

[12] Luo JC, Jin LH, Zhong YS, Xu XY, Zhang ZY, Chen J, Chen ZX, Li S, Zhang XD, Qian JC. Sotagliflozin provides additional benefits for high-fat diet-induced cardiac inflammatory injury by extra inhibiting P38MAPK and JNK. International Immunopharmacology. 2025 May 16;155:114631

[13] Ray M, Guha S, Dhungana RR, Karak A, Choudhury B, Ray B, Zubair H, Ray M, Sengupta S, Bhatt DL, Goldberg RJ. Development and validation of a predictive model for the diagnosis of rheumatic heart disease in low-income countries based on two cross-sectional studies. International Journal of Cardiology Cardiovascular Risk and Prevention. 2023 Sep 1;18:200195.

[14] Srinuanchai W, Nooin R, Pitchakarn P, Karinchai J, Suttisansanee U, Chansriniyom C, Jarussophon S, Temviriyanukul P, Nuchuchua O. Inhibitory effects of Gymnema inodorum (Lour.) Decne leaf extracts and its triterpene saponin on carbohydrate digestion and intestinal glucose absorption. Journal of Ethnopharmacology. 2021 Feb 10;266:113398

[15] Ikezu UM, Ikpa CB, Ibe FC. Virtual screening and molecular docking of red Acalypha wilkesiana leaf extract-derived compounds as SGLT2 inhibitors for Type 2 diabetes therapy. World News of Natural Sciences. 2025;58:209-25.

[16] Kshirsagar RP, Kulkarni AA, Chouthe RS, Pathan SK, Une HD, Reddy GB, Diwan PV, Ansari SA, Sangshetti JN. SGLT inhibitors as antidiabetic agents: a comprehensive review. Rsc Advances. 2020;10(3):1733-56.

[17] Perkins BA, Rosenstock J, Skyler JS, Laffel LM, Cherney DZ, Mathieu C, Pang C, Wood R, Kinduryte O, George JT, Marquard J. Exploring patient preferences for adjunct-to-insulin therapy in type 1 diabetes. Diabetes Care. 2019 Sep 1;42(9):1716-23.

[18] Popovic DS, Karakasis P, Koufakis T, Fragakis N, Papanas N, Mitrovic M, Gouveri E, Patoulias D. Effect of sodium-glucose cotransporter-2 inhibitors on continuous glucose monitoring metrics, as adjunctive to insulin in adults with type 1 diabetes mellitus: a meta-analysis of randomized controlled trials. Metabolism. 2024,1;153: 155791.

[19] Shah N, Abdalla MA, Deshmukh H, Sathyapalan T. Therapeutics for type-2 diabetes mellitus: a glance at the recent inclusions and novel agents under development for use in clinical practice. Therapeutic Advances in Endocrinology and Metabolism. 2021 Sep;12:20420188211042145.

[20] Schoels M, Zhuang M, Fahrner A, Küchlin S, Sagar, Franz H, Schmitt A, Walz G, Yakulov TA. Single-cell mRNA profiling reveals changes in solute carrier expression and suggests a metabolic switch during zebrafish pronephros development. American Journal of Physiology-Renal Physiology. 2021, 1;320(5):F826-37.