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Original Article

Development and Validation of a Stability-Indicating Reverse Phase HPLC-PDA Method for Determination of Canagliflozin in Bulk and Pharmaceutical Dosage Form

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ABSTRACT

Objective: To develop and validate simple, authentic and stability indicating high performance liquid chromatographic method for determination of Canagliflozin in bulk and pharmaceutical formulations as per ICH Q2 R1 Guidelines. **Methods:** A C_{18} Column (250×4.6 mm, 5 µm particle size) with a mobile phase consisting of Acetonitrile: orthophosphoric acid in a ratio of 55:45 v/v was employed for the chromatographic study. A flow rate of 1 ml/min with an injection volume of 20 µL was selected for this study and the proposed method was validated with different parameters such as Linearity, Precision, Accuracy, Robustness, Ruggedness, Limit of Detection (LOD) and Limit of Quantification (LOQ). **Results:** The separation was achieved at a temperature of 30ºC and the eluents were observed by photo diode array detector set at 290 nm. A linear range of 1-6 µg/ml with a correlation coefficient of 0.998 unfolds good linear relationship between area and concentration in calibration curve. The retention time obtained was at 6.29 min. The LOD and LOQ were found to be 0.41 µg/ml and 1.24 µg/ml respectively. A recovery of Canagliflozin in tablet formulation was observed in the range of 99.6-99.8%. Percentage assay of Canagliflozin tablets (INVOKANA®) was found to be 99.92%. The stability of the method was demonstrated by forced degradation studies of drug in which it was degraded under conditions of hydrolysis (acidic and alkaline), oxidation, photolytic and thermal stress as per ICH guideline Q1A (R2). **Conclusion:** The proposed method is definite, meticulous and reproducible and can be used for routine analysis of Canagliflozin in bulk and pharmaceutical dosage form.

Key words: Canagliflozin, High Performance Liquid Chromatography, Method development, Stability, Validation.

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INTRODUCTION

Canagliflozin is an oral selective Sodium-Glucose co-transporter 2 (SGLT2) inhibitor used for the management of type 2 Diabetes Mellitus. The chemical name (IUPAC) of Canagliflozin is (2S,3R,4R,5S,6R)-2-{3-[5-(4-fluoro-phenyl)-thiophen-2-ylmethyl]-4-methyl-phenyl}-6-hydroxymethyltetrahydro-pyran-3,4,5-triol with molecular formula $C_{24}H_{25}FO_5S$ (Figure 1). It is white to off white solid with melting point of 95-105ºC.[1,2-4] It is soluble in many organic solvents (methanol, Dimethyl sulfoxide) but insoluble in aqueous media.[1] It curbs the transporter protein SGLT2 present in the proximal tubules of the kidney which curtails renal glucose absorption, thereby increasing urinary glucose excretion and lowering blood glucose levels. It is a product of Mitsubishi Tanabe Pharma and Janssen Pharmaceuticals, a division of Johnson and Johnson.

As per the Literature Survey, it is revealed that the drug has been estimated by Liquid chromatography[5] and Ultra High Performance Liquid Chromatography-Mass Spectroscopy (UHPLC-MS) in biological fluids like human and rat plasma.[6] Bulk drug and its marketed formulation have been analyzed by Ultraviolet Spectroscopic method[7] but no High Performance Liquid Chromatography analysis has been reported for the estimation in bulk and pharmaceutical dosage forms.

The aim and objective of the present work was to develop and validate a simple, precise, sensitive liquid chromatography method for Canagliflozin in its bulk and tablet dosage form and validate as per International Conference on Harmonization (ICH) Q2 (R2) guidelines.

EXPERIMENTAL

Materials and Reagents

Analytically pure sample of Canagliflozin was obtained from Xi'an Kingsmart Group Co. Limited, Xi'an City, China and tablet formulation (Invokana) was procured from Johnson and Johnson, New Delhi, India with labelled claim of 100 mg. Methanol, Acetonitrile (HPLC Grade) were obtained from MERCK Millipore, Germany. Analytical reagent grade orthophosphoric acid was purchased from Rankem, Mumbai, India. High-pure water was prepared by using a Millipore Milli 'Q' plus purification system.

Instruments

The HPLC system used was a Shimadzu LC 2010 system supplied with a gradient pump connected to Photo diode Array detector set at 290 nm. Lab Solutions software (Version) was used for data acquisition and system suitability calculations. An electronic analytical weighing balance (0.1 mg sensitivity, Shimadzu AU 220) and a sonicator (Sonica, model 2200 MH) were used in this study. Thermal stability studies were carried out in a dry hot air oven.

Method development

Chromatographic conditions

Chromatographic separation was attained on Shimadzu C_{18} (250×4.6 mm, 5 µm) column using mobile phase composition of 0.1% w/v ortho-phos-

phoric acid and acetonitrile in the ratio of 45:55(v/v). The mobile phase was filtered and degassed through 0.22 mm filter paper. The Flow rate was kept at 1 ml/min. A column temperature of 30°C, injection volume of 20 µL with a flow rate of 1 ml/min and the detector wavelength of 290 nm were set for the chromatographic study. The retention time obtained of Canagliflozin was at 6.29 min. Diluent was prepared by mixing 450 ml of 0.1% w/v orthophosphoric acid and 550 ml of Acetonitrile, filtered through 0.45 mm and degassed before use.

Preparation of stock solution

Accurately weighed quantity of Canagliflozin (10 mg) was transferred to a 10 ml volumetric flask, dissolved and diluted up to the mark with methanol and was ultra-sonicated for 5 min (Concentration:1000 µg/ml).[8]

Preparation of standard working solution

It was prepared by taking 1 ml of stock solution into 10 ml volumetric flask and the final volume was made up with diluent (100 µg/ml). The solution was filtered and then diluted immediately before use to appropriate concentration levels by using mobile phase.[8]

Preparation of mobile phase

The mobile phase was prepared by mixing 0.1% w/v orthophosphoric acid and acetonitrile in the ratio of 45:55 (v/v). The mobile phase was filtered through 0.45 mm and degassed before use.[8]

Analytical Method validation

The developed method was validated for different parameters like linearity, precision, accuracy, specificity, ruggedness, robustness, LOD and LOQ[5,9] as per ICH Q2A and Q2B guidelines.[10-13]

Linearity

Linear regression data over the range of 1 to 6 µg/mL for Canagliflozin with a correlation coefficient of 0.998 unfolds good linear relationship between area and concentration in calibration curve.

Accuracy

Accuracy of the method was resolved by standard addition method in which standard addition of pure API at three different concentration levels of 70%, 100% and 130% was performed in triplicate. Accuracy of the method is calculated in the terms of % recovery of the API.

Robustness

Robustness of the method was determined by varying the method parameters such as change in flow rate (±0.2 mL/min), temperature (±2%) and wavelength (±1 nm). . The analysis showed % RSD less than 2 and indicates that the method developed is robust.

Precision

Precision of the method was determined by evaluating repeatability, intraday and interday precision. Repeatability was confirmed by injecting same concentration in six replicates and corresponding areas were calculated. Intra-day and Inter-day variation was analyzed by selecting three concentrations which were 2, 4 and 6 µg/ml from linearity range. Intraday analysis was carried on same day whereas Interday analysis was carried on three different days in replicates of three. The respective peak areas for different concentrations were reported. Results are expressed in the term of % RSD which shows the precision data for the method.

Ruggedness

Ruggedness of the method was determined by carrying out the analysis by two different analysts and the respective peak areas were noted. The result was indicated by % RSD which was less than 2% indicating that the method is rugged.

Limit of Detection (LOD) and Limit of Quantification (LOQ)

A limit of detection (LOD) and a limit of quantification (LOQ) were calculated according to the formula:

$$LOD = 3.3\ \sigma/s$$

$$LOQ = 10\ \sigma/s$$

Where, 'σ' is the standard deviation of 'y' intercept of regression line and 's' is the slope of the calibration curve.

Force degradation studies

To assess the stability indicating property of the developed HPLC method stress studies were carried out under ICH recommended conditions. Forced degradation of Canagliflozin was carried out by exposing the bulk sample to acidic, alkaline, oxidative, photolytic, dry heat and neutral conditions. The aim was to study the ability of the proposed method to measure the analyte response in presence of its degradation products.[13]

Acid and alkali hydrolysis

Aliquot of 1 ml of Canagliflozin solution (10 mg dissolved in 10 ml i.e. 1 mg/ml) was transferred to a small round bottom flask. The solution was mixed with 9 ml of 0.1N hydrochloric acid or 0.1 N sodium hydroxide. The prepared solutions were subjected to reflux for 2 h in a boiling water bath. The samples were cooled to room temperature (25°C), neutralized with an amount of acid or base equivalent to that of the previously added. From the resulting neutral solution,

20 µl of each was injected into the HPLC system.

Oxidation

One milliliter of Canagliflozin solution (10 mg dissolved in 10 ml i.e. 1 mg/ml) was transferred to round bottom flask. The contents were then mixed with 9 ml of 30% hydrogen peroxide solution, and the reaction mixture was allowed to proceed at room temperature (25°C) for 2 h with intermittent shaking. A volume of 20 µl was injected into the HPLC system.

Irradiation with ultraviolet light

A sample powder of Canagliflozin (10 mg) was exposed to UV light (254 nm) for 48 h. The material was dissolved in 5 ml water. The solution was filtered with syringe filtration disk claimed concentration of 1 mg/ml. It was suitably diluted and a volume of 20 µl was injected into the HPLC system. As well, an aqueous solution of Canagliflozin (1 mg/ml) was exposed to UV light (254 nm) for 48 h, and after diluting 20 µl was injected into the HPLC system.

Thermal degradation

A sample powder of Canagliflozin (10 mg) was exposed to a temperature of 70°C for 48 h in hot air oven. The material was dissolved in 5 ml water. The solution was filtered with syringe filtration disk claimed concentration of 1 mg/ml. It was suitably diluted and a volume of 20 µl was injected into the HPLC system. As well, an aqueous solution of Canagliflozin (1 mg/ml) was exposed to a temperature of 70°C for 48 h, and after diluting 20 µl was injected into the HPLC system.

Assay of tablet

Twenty INVOKANA® tablets were weighed, average weight was calculated, and was triturated to fine powder. A powder proportionate to 10 mg was taken in a 10 ml volumetric flask to which meager amount of methanol was added. The flask is then ultra-sonicated for 15 min and volume is made up with methanol. The tablet solution is then filtered through whatman filter paper (No. 41) and from the above solution

Table 1: Linearity of Canagliflozin

Parameter	Result
Linearity Range	1-6 µg/ml
Slope	41844
Intercept	8485.7
Correlation coefficient	0.9989

Table 2: System Suitability Parameter

Parameter	Result
Retention Time	6.23 min
Theoretical Plates	9,863.195
Tailing Factor	0.919

Table 3: Accuracy Studies of Canagliflozin

Amount of sample taken (µg/ml)	Amount of standard added (µg/ml)	Percentage of Standard added	% Recovery	Tailing	T.Plate	% Relative Standard Deviation
2	1.4	70	99.6	0.925	10307.1	0.13
2	2	100	99.8	0.927	10042.24	0.11
2	2.6	130	99.7	0.926	10037.89	0.09

*Average of three determinations (n=3).

Table 4: Intra-day Precision Studies of Canagliflozin

Amount of Standard taken (µg/ml)	Area (mAU)	Retention Time (Rt) (minutes)	Tailing factor	T.plate	% Relative Standard Deviation
Day-1 (Morning)					
2	129340	6.22	0.920	9983.32	0.08
4	298710	6.23	0.920	9967.76	0.07
6	472812	6.23	0.923	10013.54	0.07
Day-1 (Afternoon)					
2	129215	6.23	0.921	9972.34	0.15
4	297640	6.23	0.923	10050.43	0.10
6	471510	6.23	0.924	10060.32	0.17
Day-1 (Evening)					
2	129105	6.23	0.925	10061.36	0.17
4	297100	6.22	0.925	10069.28	0.08
6	471440	6.23	0.926	10009.42	0.06

Table 5: Inter-day Precision Studies of Canagliflozin

Amount of Standard taken (µg/ml)	Area (mAU)	Retention Time (Rt) (minutes)	Tailing factor	T.plate	% Relative Standard Deviation
Day-1					
2	126350	6.31	0.921	9974.56	0.25
4	297046	6.29	0.922	9950.76	0.10
6	472400	6.28	0.924	10024.39	0.07
Day-2					
2	128359	6.23	0.921	9981.64	0.27
4	296540	6.23	0.923	10040.46	0.11
6	472840	6.23	0.924	10024.45	0.09
Day-3					
2	129450	6.31	0.952	10308.86	0.27
4	297220	6.29	0.950	10253.57	0.11
6	472460	6.28	0.952	10293.23	0.08

Table 6: Robustness studies of Canagliflozin

Parameter	Area (mAU)	Retention Time (Rt) (minutes)	Tailing factor	T.plate	% Relative Standard Deviation
Change in flow rate (±0.2 ml/ min)					
0.8 ml/min	287450	7.69	0.956	9882.56	0.11
1.2 ml/min	289568	5.25	0.937	10045.78	0.10
Change in Temperature (±2°C)					
28°C	296500	6.20	0.943	10013.67	0.10
32°C	294320	6.22	0.942	10054.89	0.10
Change in Wavelength (±1 nm)					
289 nm	288640	6.23	0.934	11095.76	0.12
291 nm	289430	6.22	0.940	9876.54	0.11

Table 7: Ruggedness studies of Canagliflozin

Analyst	Area (mAU)	Retention Time (minutes)	Tailing factor	T.plate	% Relative Standard Deviation
Analyst 1	297630	6.23	0.954	10032.83	0.10
Analyst 2	298320	6.22	0.951	10134.76	0.10

Table 8: Stability studies of Canagliflozin

Sample	Concentration used (µg/ml)	Concentration left after degradation (µg/ml)	% Recovery
Acid Hydrolysis	360	280.27	77.85
Alkaline Hydrolysis	500	371.63	74.33
Oxidation	830	594.91	71.68
Photolytic	100	70.94	70.94
Thermal	100	83.76	83.76

Table 9: Assay of Canagliflozin Tablets (INVOKANA®)

Name of the Formulation	Labelled claim	Amount found (%)*	% Relative Standard Deviation
INVOKANA®	100 g	99.92%	0.11

*Average of three determinations.

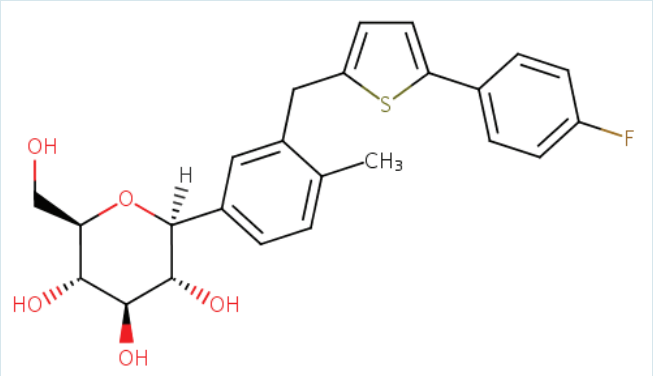

Figure 1: Structure of Canagliflozin.[1]

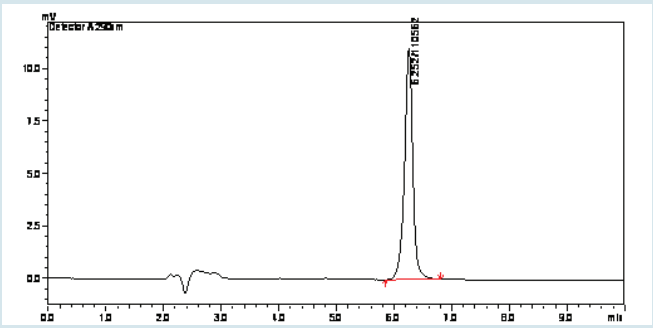

Figure 2: Typical Chromatogram of Canagliflozin at 290 nm.

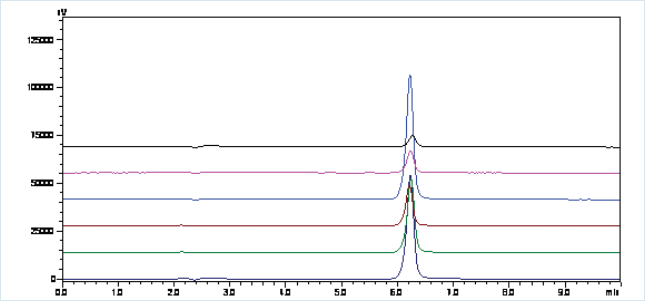

Figure 3: Overlay Chromatogram of Canagliflozin (Different aliquots; 1-6 µg/ml) at 290 nm.

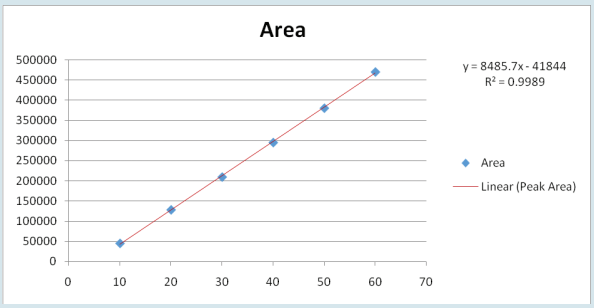

Figure 4: Calibration Curve of Canagliflozin.

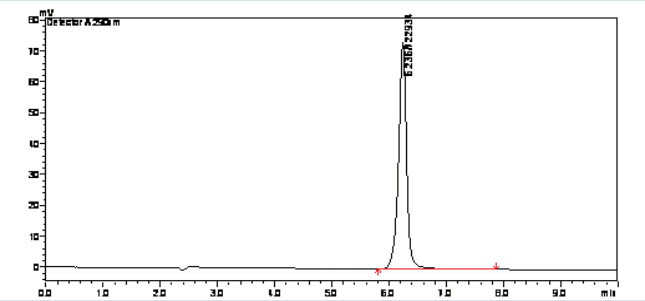

Figure 5: Accuracy chromatogram at 70% level.

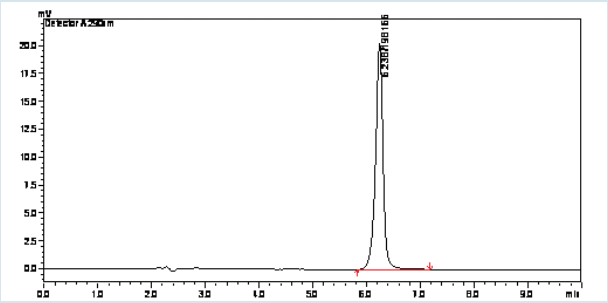

Figure 6: Accuracy Chromatogram at 100% level.

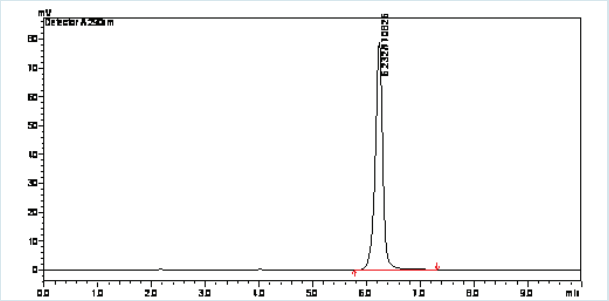

Figure 7: Accuracy Chromatogram at 130% level.

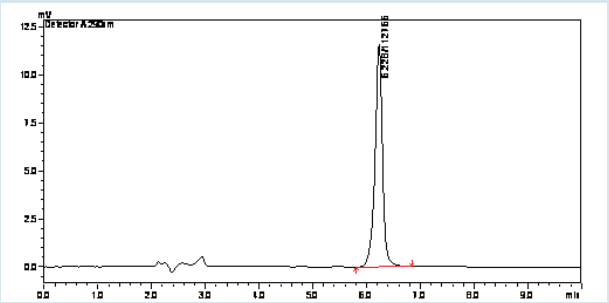

Figure 8: Chromatogram of Intra-day Precision-Morning.

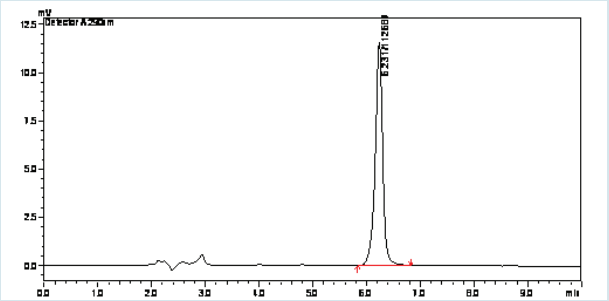

Figure 9: Chromatogram of Intra-day Precision-Afternoon.

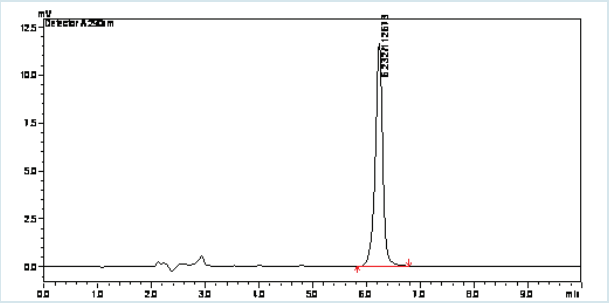

Figure 10: Chromatogram of Intra-day Precision-Evening.

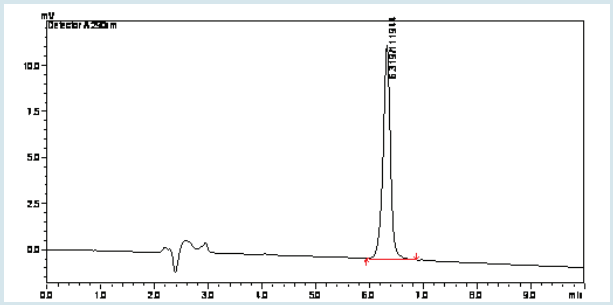

Figure 11: Chromatogram of Inter-day Precision-Day 1.

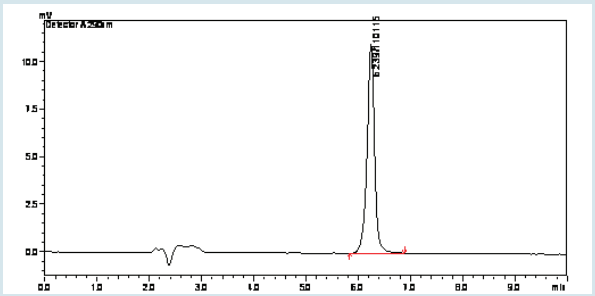

Figure 12: Chromatogram of Inter-day Precision-Day 2.

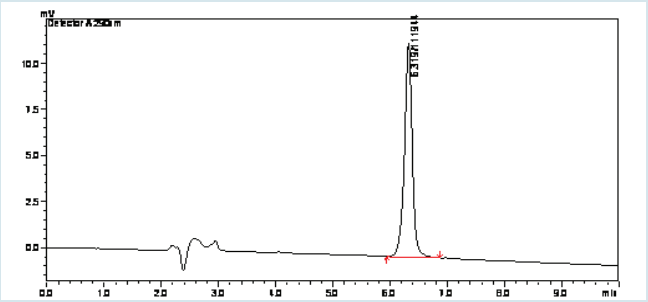

Figure 13: Chromatogram of Inter-day Precision-Day 3.

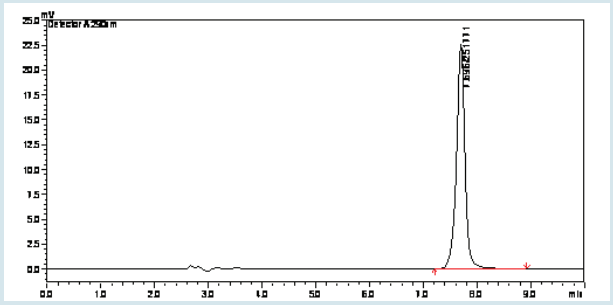

Figure 14: Chromatogram of Robustness at flow rate of 0.8 ml/min".

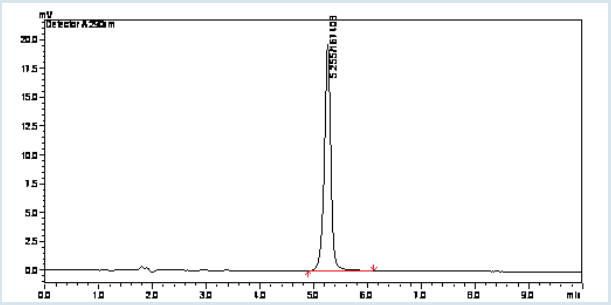

Figure 15: Chromatogram of Robustness at flow rate of 1.2 ml/min.

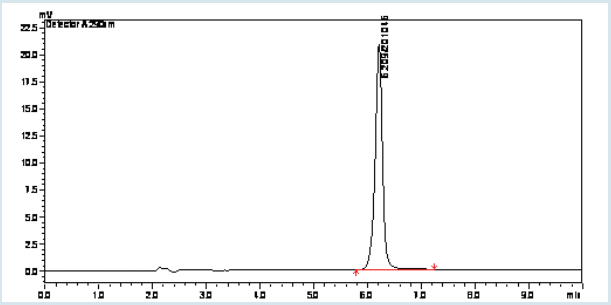

Figure 16: Chromatogram of Robustness at 28°C.

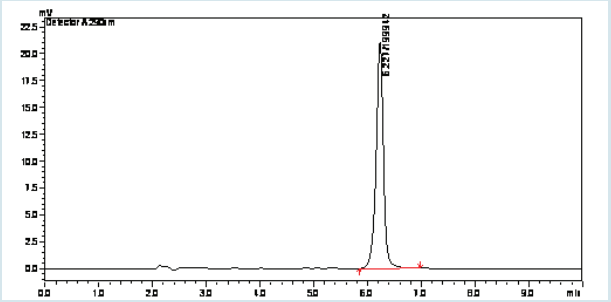

Figure 17: Chromatogram of Robustness at 32°C.

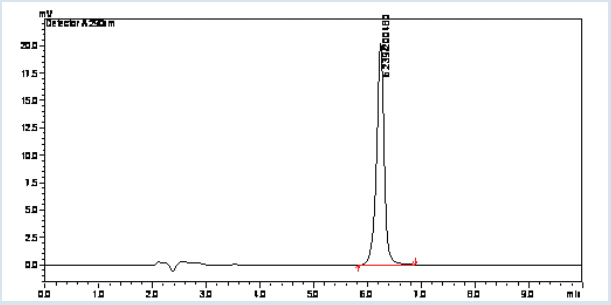

Figure 18: Chromatogram of Robustness at 289 nm.

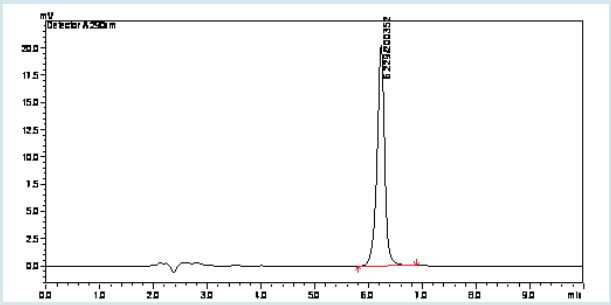

Figure 19: Chromatogram of Robustness at 291 nm.

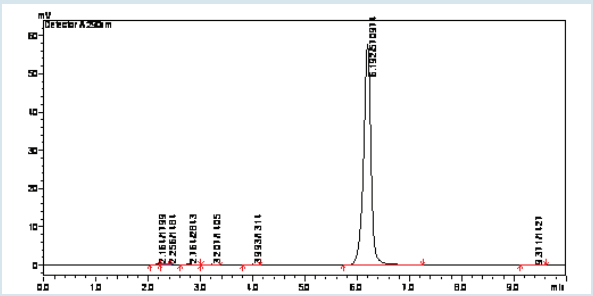

Figure 20: Chromatogram of Degradation-Acid Hydrolysis.

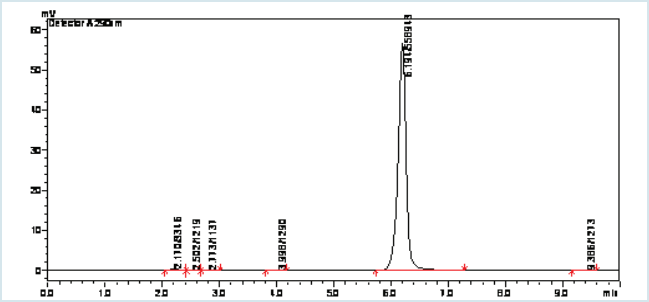

Figure 21: Chromatogram of Degradation-Alkaline Hydrolysis.

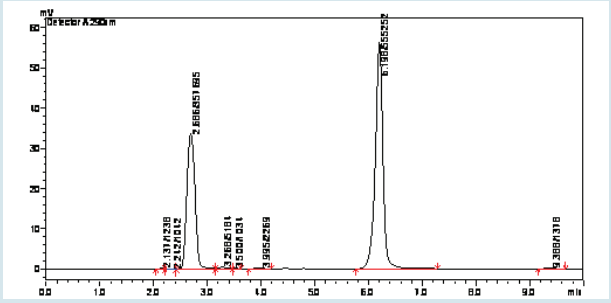

Figure 22: Chromatogram of Degradation-Oxidation.

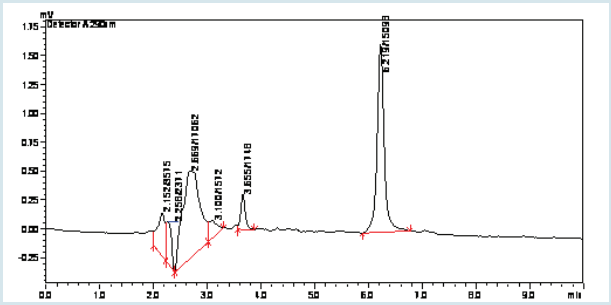

Figure 23: Chromatogram of Degradation-Photolytic.

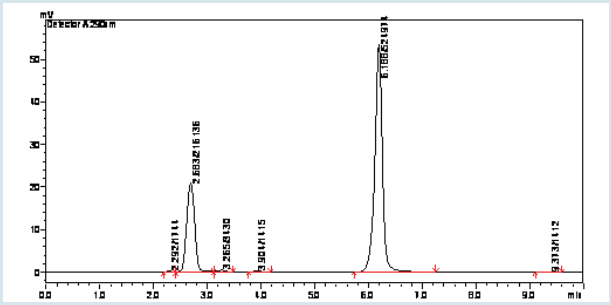

Figure 24: Chromatogram of Degradation- Thermal.

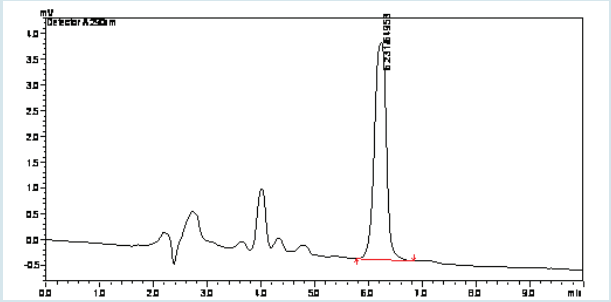

Figure 25: Chromatogram of Canagliflozin Tablets (INVOKANA®).

10 mL is diluted to 100 mL with diluent so as to get 100 µg/mL for the assay. The resulting solution was again filtered and then diluted with mobile phase to obtain final dilution of Canagliflozin (4 µg/ml).

RESULTS AND DISCUSSION

Various mobile phases of different compositions were tested so as to develop an optimum mobile phase to achieve a satisfactory separation and good peak symmetry for Canagliflozin. A mobile phase consisting of Acetonitrile: orthophosphoric acid (55:45 v/v) was developed. Analysis was carried out on the basis of peak area with UV detection at 290 nm (Figure 2). The retention time obtained for Canagliflozin was at 6.29 min. The detector response was linear in the concentration range of 1-6 µg/ml. Figure 3 represents overlay chromatogram of canagliflozin.

Validation of the proposed method

Linearity

Linear correlation was attained between peak area used absorbance vs concentration of Canagliflozin in the range of 1-6 mg/ml. The linearity of the calibration curve was validated by the high value of correlation co-efficient of regression as shown in Figure 4 and the results are shown in Table 1 & 2.

Accuracy

The accuracy experiments were carried out by the standard addition method. The high value of recoveries obtained for Canagliflozin indicate that method is accurate as shown in Table 3 and Figure 5-7.

Precision

The %RSD values of intra-day and inter-day for Canagliflozin are less than 2% which reveal that the proposed method is precise and is shown in Table 4 and 5. Intra-day and inter-day precision are depicted in Figure 8-10 and 11-13 respectively.

Robustness

The % RSD value of robustness which is less than 2% for Canagliflozin reveals that the proposed method is robust as shown in Table 6. Figure 14-19 represents robustness under different conditions (change in flow rate, temperature and wavelength).

Ruggedness

The % RSD values of ruggedness for Canagliflozin reveal that the proposed method is quite rugged as shown in Table 7.

Limit of Detection (LOD) and Limit of Quantification (LOQ)

The LOD and LOQ of Canagliflozin were found 0.41 µg/ml and 1.24 µg/ml respectively.

STABILITY INDICATING STUDY

The ICH guideline characterized stability testing of drug substances and products requires the stress testing to be carried out to enlighten the inherent stability characteristics of the active substance and also to produce a rapid identification of differences that might result from changes in the manufacturing processes or source sample. Vulnerability to oxidation, hydrolytic, photolytic and thermal stabilities are the required tests. An ideal stability indicating method is one that not only evaluates the standard drug alone but also resolves its degradation products.

From the forced degradation, it was clear that in case of thermal stability Canagliflozin was most stable under the employed stress conditions as shown in Table 8. In case of acid hydrolysis, alkaline hydrolysis and oxidation degradation was observed and is shown in the respective chromatograms (Figure 20-24) but maximum degradation was seen on irradiation with U.V light (Figure 25). Nonetheless, the method was able to isolate completely the degradation products from the intact Canagliflozin.

This confirmed stability indicating property of the proposed method. The concentration of the produced degradation products analogous to the intact Canagliflozin was calculated and found to be 22.15%, 25.65%, 28.32%, 29.05%, 16.24% in case of acid hydrolysis, alkaline hydrolysis, oxidation, photolytic and thermal stability respectively.

ANALYSIS OF MARKETED FORMULATION

% Mean recovery in formulation is 99.92 and % relative standard deviation is less than 2% which is within the limits. Table 9 displays the assay of the formulation.

CONCLUSION

The current research epitomizes the report that deals with the development of a stability indicating RP-HPLC method for determination of Canagliflozin in bulk as well as pharmaceutical dosage form. The values of accuracy, precision, robustness, ruggedness, LOD and LOQ were within the limits. Canagliflozin is very sensitive so it is unstable in alkaline, acidic, oxidative, thermal and photo light. Statistical analysis for the results clearly demonstrate that the method is suitable for the determination of Canagliflozin in bulk and tablet forms without any interference from the degradation products, and it is endorsed for routine use in quality control industry laboratories.

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CONFLICT OF INTEREST

Authors report no conflicts of interest in this work.

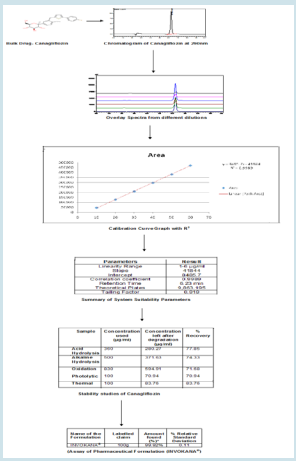
ABBREVIATIONS USED

HPLC: High Performance Liquid Chromatography, **LOD:** Limit of Detection, **LOQ:** Limit of Quantification, **SGLT2:** Sodium Glucose co-transporter2, **UHPLC-MS:** Ultra High Performance Liquid Chromatography-Mass Spectroscopy, **DMSO:** Dimethyl sulfoxide, **µg:** microgram, **ICH:** International Conference on Harmonization, **RSD:** Relative Standard Deviation.

REFERENCES

1. Harsharan PS, Ishpreet K, Gunjan S. Sodium Glucose Co-Transporters-2 (SGLT2) Inhibitors as a New Class of Anti-diabetic Drugs: Pharmacokinectics, Efficacy and Clinical Significance. Int J Pharm Sci Rev Res. 2015;33(1):40-7.
2. Song JC, Kaubisch S. Canagliflozin-an emerging treatment option for type 2 diabetes mellitus. Formulary Available at: http://formularyjournal.modernmedicine.com/formulary-journal/news/user-defined-tags/canagliflozin/ canagliflozin-emerging-treatment-option-type. Accessed: 30 November 2014.
3. Shelley E, Lesley J. Scott. Canagliflozin: First Global Approval. Drugs. 2013;73:979-88.
4. Neumiller JJ, White JR, Campbell RK. Sodium-glucose co-transport inhibitors: progress and therapeutic potential in type 2 diabetes mellitus. Drugs. 2010;70(4):377-85.
5. Muzaffar I, Nasr YK, Amer MA, Khalid A.Al-R. A simple and sensitive high performance liquid chromatography assay with a fluorescence detector for determination of canagliflozin in human plasma. Anal Methods. 2015;7(7):3028-35.
6. Muzaffar I, Essam E, Khalid AAl-R, Yousif AA, Naser LR. Rapid determination of canagliflozin in rat plasma by UHPLC–MS/MS using negative ionization mode to avoid adduct-ions formation. Talanta. 2015;132(1):29-36.
7. Ishpreet K, Sharad W, Harsharan PS. Development and Validation of UV Spectroscopic Method for Determination of Canagliflozin in Bulk and Pharmaceutical Dosage Form. Pharm Methods. 2015;6(2):1-1.
8. Skoog DA, Holler FJ, Nieman TA. Principles of Instrumental Analysis. 6th ed. Thomson Brooks/Cole.; 2007. p. 762-63,816-27.
9. Srinivasu K, Rao JV, Raju N. A validated RP-HPLC method for the determination of atazanavir in pharmaceutical dosage form. E J Chem. 2011;8(1):453-6.
10. International Conference on Harmonization (ICH), Validation of Analytical Procedures: Text and Methodology Q2 (R1), Geneva, 2005.
11. ICH Harmonized-Tripartite Guidelines. Validation of Analytical Procedure: Text

PICTORIAL ABSTRACT



SUMMARY

- Canagliflozin is the novel SGLT2 inhibitor with excellent clinical results on humans.
- As per the literature review, there is no developed HPLC method on the drug except U.V. spectroscopy method developed by Kaur *et al.*
- An economical and easy HPLC method is developed and validated as per ICH guidelines.
- The Chromatogram of the prepared samples was analyzed at 290 nm with excellent linearity with a R^2 value of 0.9989.
- Also, canagliflozin sample was treated with various agents like acid, base, oxidizing agent and others to determine its stability.
- Analysis of Pharmaceutical Dosage form showed the percentage recovery of 99.92%.

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