WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

A Brief Review on Analytical methods for estimation of Dapagliflozin, Empagliflozin, Metformin and Saxagliptin

K. Suneetha*, M. Praveen[1], N. Mounika[2], Shrusti Patil[3], P. Rishika[4], Sarvesh[5]

[*] SSJ College of Pharmacy, VN Pally, Hyderabad, Telangana.
[1-5] SSJ College of Pharmacy, VN Pally, Hyderabad, Telangana.

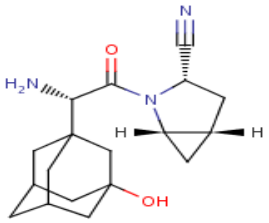
ABSTRACT:

Pharmaceutical analysis is an integral part of the drug development process, playing a crucial role at various stages, including formulation development, stability studies, and quality control. It is essential for both qualitative and quantitative characterization of the composition of different dosage forms. A comprehensive literature survey serves as the foundation for focused research activity in the field. This review article aims to discuss and compile various analytical methods available in the literature for the determination of oral anti-diabetic drugs, specifically Saxagliptin (SAXA), Dapagliflozin (DAPA), Empagliflozin (EMPA), and Metformin Hydrochloride (MET), which are commonly used in the treatment of Type II diabetes mellitus. Techniques such as UV spectrophotometry, High-Performance Thin-Layer Chromatography (HPTLC), Ultra-Performance Liquid Chromatography (UPLC), Reverse-Phase High-Performance Liquid Chromatography (RP-HPLC), and High-Performance Liquid Chromatography (HPLC) are evaluated and compared. This review provides detailed insights into the comparative utilization of these analytical techniques for the determination of SAXA, DAPA, EMPA, and MET. The article will be beneficial for guiding future analytical investigations aimed at estimating these drugs in pharmaceutical and biological samples.

KEYWORDS: Saxagliptin, Metformin, Dapagliflozin, Empagliflozin.

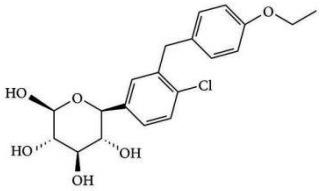
INTRODUCTION:

SAXAGLIPTIN:



Saxagliptin is a type 2 diabetes medicine that is taken orally. It suppresses the degradation of incretin hormones like GLP-1 and GIP by inhibiting the DPP-4 enzyme. By increasing insulin production and decreasing glucagon release, incretins are essential for glucose metabolism.It is identified medically as (1S,3S,5S).-2-[(2S)-2-aminoDec-1-yl) acetyl-2-(3-hydroxytricyclo [3.3.1.1³, ⁷][3.1.0] -2-azabicyclo 3-carbonitrile hexane.Saxagliptin adverse drug reactions include pancreatitis, severe allergic responses, including rashes, itching, and breathing difficulties (anaphylaxis). It might make complications from heart failure more likely.

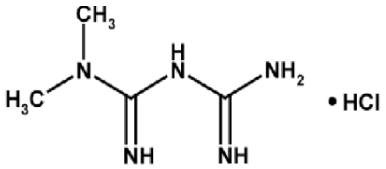
DAPAGLIFLOZIN:



Dapagliflozin is a medication used to treat type 2 diabetes, heart failure, and chronic kidney disease. SGLT2 is responsible for reabsorbing glucose from renal tubes, by inhibiting SGLT2 dapagliflozin prevent glucose reabsorption leading to increased glucose excretion in the urine.
Its chemical name is (2S,3R,4R,5S,6R)-2-[4-chloro-3-(4-ethoxybenzyl) phenyl]-6-(hydroxymethyl) oxane-3,4, 5.

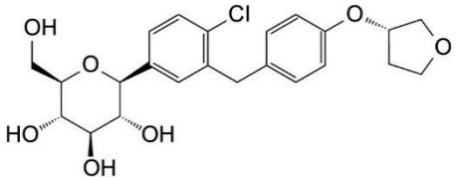
Adverse reactions of dapagliflozin are Genitourinary and Fungal infections, and it can cause Euglycemic DKA and osmotic diuresis.

METFORMINE HYDROCHLORIDE:



Metformin hydrochloride is a biguanide that primarly enhances insulin sensitivity and reduces the level of glucose generated by the liver.AMP activated protein kinase (AMPK) is activated in order for it to operate properly. which decreases Gluconeogenesis. Chemically Metformin hydrochloride is 3-(diamino methylidene)-1,1-dimethylguanidine . Adverse reactions of Metformin are Gastrointestinal infections, Abdominal discomfort and Flatulence. It is mainly used to reduce the risk of heart disease and stroke in diabetic patient and beneficial for insulin resistance conditions like polycystic ovary syndrome.

EMPAGLIFLOZIN:



Empagliflozin is a SGLT2 inhibitor. In the kidneys it is responsible for reabsorbing glucose from the urine and helps in glucose excretion.
chemical name -2-[4-chloro-3-[[4-[(3*S*)-oxolan-3-yl] oxyphenyl] methyl] phenyl]-6-(hydroxymethyl) oxane3,4,5-triol .
Adverse Reactions of Empagliflozin are yeast infections, increased urination leads to polyuria and causes dehydration and hypotension.
It is used to lower risk of hypoglycaemia and cardiovascular conditions.

REPORTED ANALYTICAL METHODS:

TABLE:1 METHODS FOR SAXAGLIPTIN AND DAPAGLIFLOZIN:

S.NO.	Method	Author	Wave length	Description	Linearity	Reference
1	RP-HPLC	Sayali s, Santosh s, Sanjay j.	225nm	Mobile phase: Buffer Acetonitrile. Stationary phase:C18 Column. Flowrate: 1.2ml/min. Ph:5.5-0.02.	2- 2µgml 4-24 µg/ml	1
2	STABILITY INDICATING HPLC	Magharla Dasaratha	248nm	API & Formulation S.P: Xterra RP18 M.P: Acetonitrile. Flow rate:1ml/min.	100-500 µg/ml 50-250 µg/ml	2
3	HPLC	Sharmila Donepudi	254nm	Mobile phase: Buffer, phosphate buffer, AmoniumAcetate and organic solvent Stationary phase: C18 Column PH:5.0 -7.	0.01-0.5 µg/ml	3

4	UV SPECTROPHOTOMETRIC	Ragavendra Singh Bhadauri	224nm-274nm	It follows Beers law Concentration range -2-10ml LOD:0.040ml LOQ:0.0120ml	5-50 µg/ml	4
5	UPLC	S Madhavi A. Pamella Rani	254nm	Mobile phase: Formic acid in water, Acetonitrile Statonaryphase:C18 in Reverse phase.	5-50 µg/ml	5

Table-2: Methods for Dapagliflozin and Metformin

S.NO	Method	Author	Wavelength	Description	Linearity	Reference
1	RP-HPLC	Waqar siddique	260nm	Mobile phase: Acetonitrile, orthophosphoric acid Stationaryphase:C18column Flowrate:1.0ml/min LOQ:9.95 µg/ml LOD:2.98 µg/Ml	5-25 µg/ml	6
2	UV-SPECTROPHOTOMETRIC	Bhavya Sri, Surekha andM.Sumakanth	222nm-232nm	Determined by Q absorption ratio. Diluent-water Correlation coefficient value-0.9999 Limit of detection:0.0241 µg/ml Limit of Quantification :0.0732 µg/ml	2-32 µg/ml	7
3	QBD ANALYTICAL METHOD BY RPHPLC	Dr. Priyanka Mathur	210nm	Stationary phase: C18 Mobile phase: orthophosphoric acid Flow rate: 1.0 ml/min	20-100 µg/ml 50-100 µg/ml	8

Table 3: Method for metformin, saxagliptin, Dapagliflozin

S.NO	Method	Author	Wave length	Description	Linearity	Reference
1	HPLC	Swetha Shivashankar suman	272nm	Stationary phase: Methanol Mobile phase: Acetonitrile pH:3.5 Flowrate:1.0ml/min	5-25 µg /ml 0.1-0.5 µg /ml	9

2	STABILITY INDICATING HPLC	Krishna Rao Vanak Alapati	230nm	API and Formulation S.P: Kromasil C18 M. P: Phosphate Buffer : Acetonitrile pH:3 Flow rate:1.0ml/min	125-750 µg/ml	10
3	UV-SPECTROPHOTOMETRIC	Priya Barbude, Mukund Tawar	232nm 212nm	Bulk form and Tablet dosage form Stationary Phase: Methanol Mobile phase: Acetonitrile	10-15 µg /ml 5-25 µg /ml	11

Table-4 Methods for Metformin and Saxagliptin:

S.NO	Method	Author	Wavelength	Description	Linearity	Reference
1	RP-HPLC	K. Satyanarayana	220nm	Stationary phase: C18 Mobile phase: Acetonitrile Flow rate:0.6ml/min Lod:0.112ml LOQ:0.373ml	1.0-1.2 µg/ml	12
2	UV SPECTROPHOTOMETRIC	E.V.S Subramanyam	227nm	Concentration:5-50 µg/ml	5-50 µg/ml	13
3	HPLC	S. Roshan	233nm	API Drug Stationary phase:C18 Mobile phase: Acetonitrile Flow rate:1.0ml	2.5-5.0 µg/ml	14

Table-5 Method for Empagliflozin and Metformin:

S.NO	Method	Author	Wavelength	Description	Linearity	Reference
1	RP-HPLC	Vinay kumar	260 nm	Stationary Phase: Kromosil C18 column (50mm X4.6mm; 5µm) Mobile Phase: Acetonitrile Orthophosphoric acid	1.25–7.50µg/ml EMPA; 125-750µg/ml MET	15

				Flow rate:1ml/min LOD: 0.01µg/ml EMPA; 0.50µg/ml MET LOQ: 0.03µg/ml EMPA; 1.52µg/ml MET		
2	HPLC	Alaa Samin	255nm	Stationary Phase: C18 SBMobile Phase: Acetonitrile Flow rate: 1mi/min LOD: 0.352µg/ml EMPA; 36.80µg/ml MET LOQ: 1.055µg/ml EMPA; 110.401µg/ml MET	3.13-9.38 µg/ml EMPA;250-750 µg/ml MET	16
3	HPTLC	Manoj kumar	242nm	Stationary Phase: Silica gel precoated plates Mobile Phase: 2 % Ammonium acetate: Isopropyl alcohol: Triethyl - amine LOD: 24.65ng/band EMPA; 705.21ng/band MET LOQ: 74.70ng/band EMPA; 2136.99ng/band MET	125 -750 ng/band EMPA; 5000 – 30000 ng/band MET	17
4	UV	Patil sushil	224nm	Solvent: Methanol LOD: 0.036µg/ml EMPA; 0.04µg/ml MET LOQ: 0.111 µg/ml EMPA; 0.1402 µg/ml MET	Linearity range: 1-3µg/ml EMPA; 10-50µg/ml MET	18

Table-6 Methods for Empagliflozin:

S.NO	Method	Author	Wavelength	Description	Linearity	Reference
1	RPHPLC	Vijaya Sri	296nm	S.P: C18 column Mobile Phase: Methanol: Water with 0.1 % Ortho phosphoric acid Flow rate: 0.8ml/min Rt: 1.283 min	Linearity : 2.5–1.50 µg/ml	19
2	UV	Sushil D Patil	224nm	Solvent: Methanol: Water LOD: 0.036 µg/ml LOQ: 0.111 µg/ml	Linearity : 1-3 µg/ml	20
3	UV	Shaik Bima Benzair	223nm	Solvent: Methanol and Water LOD: 0.10 µg/ml LOQ: 0.33 µg/ml	Linearity : 1-30 µg/ml	21

CONCLUSION:

The study provides a variety of analytical techniques for measuring the amount of metformin, saxagliptin, dapagliflozin, and empagliflozin in pharmace utical dosage forms and bulk.A number analytical methods for determining the concentrations of metformin, saxagliptin, dapagliflozin, and empaglifloz in in bulk and pharmaceutical dose forms are provided by the study.. These methods are widely utilized due to their simplicity, economy, precision, accuracy, and reproducibility in drug estimation.

This review highlights the prevalence of liquid chromatographic methods, including RPHPLC and HPLC, for the measurement of metformin, saxaglipti n, empagliflozin, and dapagliflozin

Future research into new analytical techniques for licensed antidiabetic medications will benefit greatly from the insights this analysis offers.

REFERENCES:

1. **Sayali S. More, Sandeep S. Sonawane, Santosh S. Chhajed, Sanjay J. Kshirsagar**. (2018) Development and Validation of RP-HPLC Method for Simultaneous Estimation of Saxagliptin and Dapagliflozin in Tablets. Asian J. Pharm. Tech. 2018; 8 (3):145-148.
2. **Thiyagarajan Deepan, Magharla Dasaratha al.** (2018**)** Stability indicating HPLC method for the simultaneous determination of dapagliflozin Saxagliptin in bulk and dosage form. Current Issues in Pharmacy and Medical Sciences, Vol.31,39-43.
3. **Sharmila Donepudi, Suneetha Achanta**. (2019) Simultaneous Estimation of Saxagliptin and Dapagliflozin in Human Plasma by Validated High Performance Liquid Chromatography - Ultraviolet Method. Turkish journal of Pharmaceutical Science. 2019 Mar 27;16(2):227–233.
4. **Bhadauria RS, Agarwal V. (**2020) Development and Validation of UV Spectroscopic Method for Simultaneous Estimation of Dapagliflozin and Saxagliptin in marketed formulation. Journal of Drug Delivery Therapeutics Vol 9(4-s):1160-4.
5. **S. Madhavi and A. Prameela Rani al.** (2017Simultaneous RP-UPLC method for dapagliflozin and Saxagliptin. World Journal of Pharmaceutical Research.Vol-6,12-9703
6. **Waqar Siddique Zulcaif, Hassan Umar**. (2024) Method development and validation of Metformin HCL and Dapagliflozin by using RPHPLC. AK Journal 10.1556/1326.2024.01226..
7. 7.**Dr. K. Bhavyasri al**. (2020) A Novel Method Development and Validation of Dapagliflozin and Metformin Hydrochloride using Simultaneous Equation Method by UV– Visible Spectroscopy in Bulk and Combined Pharmaceutical Formulation including Forced Degradation Studies. Journal of Pharmaceutical Sciences and Research. Vol. 12(8),2020, 1100-1105
8. **Reddy, P. K. C., & Mathur, P.** (2022). A QBD driven analytical method development and validation of metformin and dapagliflozin by using reverse phase-high performance liquid chromatography. International Journal of Health Sciences. 6(S4), 8237–8248.
9. **Suman, S. S., & Chaubey, R**. (2022). Method development of metformin, saxagliptin and dapagliflozin in marketed formulation by HPLC. International Journal of Health Sciences, 6(S8), 5927–5936.
10. **Krishna Rao Vankalapati, Pallavi A, Sathyanarayana B**. (2022). Stability-indicating HPLC method development and validation for simultaneous estimation of metformin, dapagliflozin, and saxagliptin in bulk drug and pharmaceutical dosage form. Biomedical Chromatography,36(7), e5384.
11. **Priya Barbuda, Mukund Tawara, Prashant Burange**. Method Development using a UV Visible Spectrophotometer for the Simultaneous Estimation of Metformin (MET), Saxagliptin (SXG), and Dapagliflozin (DGF) in Marketed Formulation. Asian Journal of Pharmaceutical Analysis. (2022) 12(4):243-7.
12. **K. Satyanarayana al**. (2015). Development and Validation of a Method for Simultaneous Determination of Metformin and Saxagliptin in a Formulation by RP-HPLC. American Journal of Analytical Chemistry. vol.6 No.11,841-850.
13. **Vaughan Fernandes, E.V.S. Subramanyam al**. (2018). Method Development and Validation for Determination of Metformin Hydrochloride and Saxagliptin in Bulk and Marketed Preparation. International Journal of Chemical & Pharmaceutical Analysis.Vol-5 (3),1446, 2395-2466.
14. 14.**S. Roshan al.** (2022). Analytical Method Development and Validation for Simultaneous Estimation of Metformin and Sax gliptin. International Journal of Pharmaceutical Sciences, and Research.2022, 13(6).2497-2507.
15. 15. **Vinay Kumar D et al**. (2018). A New Validated Stability Indicating RPHPLC Method for Simultaneous Estimation of Metformin Hydrochloride and Empagliflozin in Tablet Dosage Forms. International Research Journal of Pharmacy and Medical Sciences. 2018;1(5):16-22.
16. 16.**Alaa S. Amin et al**. Simultaneous for the Estimation of Metformin and Empagliflozin in Pharmaceutical Dosage Form by HPLC Method. Journal Of Pharmacy and Biological Sciences. 2019;14(1):75-80.
17. 17. **Manoj Kumar K. Munde et al**. A Novel Validated Stability Indicating Analytical Method for Simultaneous Quantification of Metformin Hydrochloride and Empagliflozin in Bulk and Marketed Formulation by HPTLC using Box-Wilson Experimental Design Approach. 2020;54(3): S644-S656.
18. 18.**Patil Sushil D**. Development and validation of UV Spectrophotometric method for simultaneous estimation of Empagliflozin and Metformin Hydrochloride in bulk drugs. Asian Journal of Pharmaceutical analysis. 2017;7(2):117-123.
19. 19. **Vijaya Sri K et al.** (2015). A Rapid RP-HPLC Method development and Validation for the Analysis of Linagliptin in Bulk and Pharmaceutical Dosage Form. Asian Journal of Pharmaceutical Analysis. 2015;5(1):16-20.
20. 20. **Sushil D. Patil et al**. (2017) Development and Validation of Simple UV- Spectrophotometric Method for the Determination of Empagliflozin. Asian Journal of Pharmaceutical Analysis. 2017;7(1):18-22.
21. 21. **Shaik Bima Benazir et al.** (2021) Method Development and Validation of Empagliflozin in Bulk and Pharmaceutical Dosage Form using UV Spectroscopy. Asian Journal of Pharmaceutical Analysis. 2021;11(2):123-126.