

PHARMACOLOGICAL ASSESSMENT OF MOBILE RADIATION IMPACT ON VILDAGLIPTIN EFFICACY IN ALLOXAN-INDUCED DIABETIC RODENTS

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KEYWORDS

Mobile radiation, Alloxan-Induced Diabetes, Antidiabetic Activity, Pharmacological Efficacy, Hypoglycemic Response, Electromagnetic radiation, Drug interaction, Medication safety, EMR exposure.

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ABSTRACT

The widespread usage of cell phones has sparked worries about how electromagnetic radiation (EMR) may affect the pharmacological effectiveness of medicinal substances. Vildagliptin is a dipeptidyl peptidase-4 (DPP-4) inhibitor that is commonly used to treat type 2 diabetes mellitus. The current study assessed the impact of mobile phone radiation, particularly when using Bluetooth and Flight modes, on the drug's chemical stability and antidiabetic effectiveness. EMR-exposed and non-exposed vildagliptin were given to alloxan-induced diabetic Wistar rats for pharmacological evaluation. Variations in the glucose-lowering efficacy were assessed by tracking changes in fasting blood glucose levels. Significant alterations in the drug's distinctive functional groups (FTIR) and thermal behaviour (DSC) were brought about by exposure to EMR, especially in Bluetooth mode. Additionally, the active drug content (HPLC) decreased. The hypoglycaemic response in diabetic rats was significantly attenuated in correlation with these chemical alterations, suggesting a possible loss of therapeutic efficacy. The results highlight the necessity of strict handling and storage procedures to maintain the stability and effectiveness of pharmaceutical products by indicating that electromagnetic radiation may jeopardize vildagliptin's pharmacodynamic activity as well as its chemical integrity.

INTRODUCTION

The prevalence of non-communicable diseases, especially cardiovascular ailments and type 2 diabetes mellitus, is rapidly increasing in India. In the 1970s, less than 3% of Indian adults had type 2 diabetes; by 2000, that number had risen to almost 12%, and by 2025, it is predicted that about 60 million people will have the disease. This increasing prevalence of the condition emphasizes how vitally important safe and efficient antidiabetic treatments are.

Vildagliptin, an inhibitor of dipeptidyl peptidase-4 (DPP-4), is frequently given to treat type 2 diabetes because of its demonstrated ability to improve glycaemic control. Because diabetes is a chronic condition, people frequently keep their prescription drugs close to their personal electronics, including cell phones. Concerns regarding the pharmacological and biological effects of electromagnetic radiation (EMR) released by mobile phones have been raised by their frequent and extensive use. Depending on the intensity, frequency, and duration of exposure, prolonged or repeated close-quarters exposure to mobile phone radiofrequency (RF) radiation can cause changes in human systems, even though it is non-ionizing and works at relatively low power (0.1-2 watts; 450-2700 MHz).

The impact of EMR on pharmaceutical products, especially those that are regularly stored or transported close to mobile phones, has received relatively little attention, despite the fact that its potential health risks—such as effects on neurological function,

auditory pathways, and potential carcinogenesis—have been hotly debated. The chemical stability and therapeutic effectiveness of some medications may be significantly impacted by such interactions.

The goal of the current study was to assess how mobile phone radiation, particularly when using Bluetooth and Flight mode, affected the physicochemical stability and antidiabetic effectiveness of vildagliptin tablets. This study intends to offer evidence-based insights into the possible influence of EMR on drug stability and therapeutic performance by combining cutting-edge analytical techniques with in vivo pharmacological assessment using alloxan-induced diabetic Wistar rats. This will encourage safer handling and storage procedures for necessary medications.

PURPOSE

The current study intends to assess how electromagnetic radiation (EMR) from mobile phones affects the pharmacological effectiveness and physicochemical stability of vildagliptin, a common dipeptidyl peptidase-4 (DPP-4) inhibitor used to treat type 2 diabetes mellitus. The study aims to ascertain if long-term exposure to EMRs jeopardizes the integrity, potency, or therapeutic efficacy of vildagliptin dosage forms, given the growing prevalence of mobile phone use and the devices' frequent closeness to patient-carried pharmaceuticals. This study intends to clarify possible hazards related to EMR-related drug degradation and to draw attention to the wider implications for medication safety, storage procedures, and long-term treatment outcomes in diabetic populations by contrasting

vildagliptin tablets exposed to Bluetooth and Flight mode radiation with non-exposed controls.

MATERIAL AND METHODS

Using a system that mimics actual radiation levels, the tablets in the experimental group were exposed to mobile radiation. The control group should remain in the same settings, such as Flight or Bluetooth mode, but not be exposed to radiation.

Vildagliptin Tablet used in the research is given below:

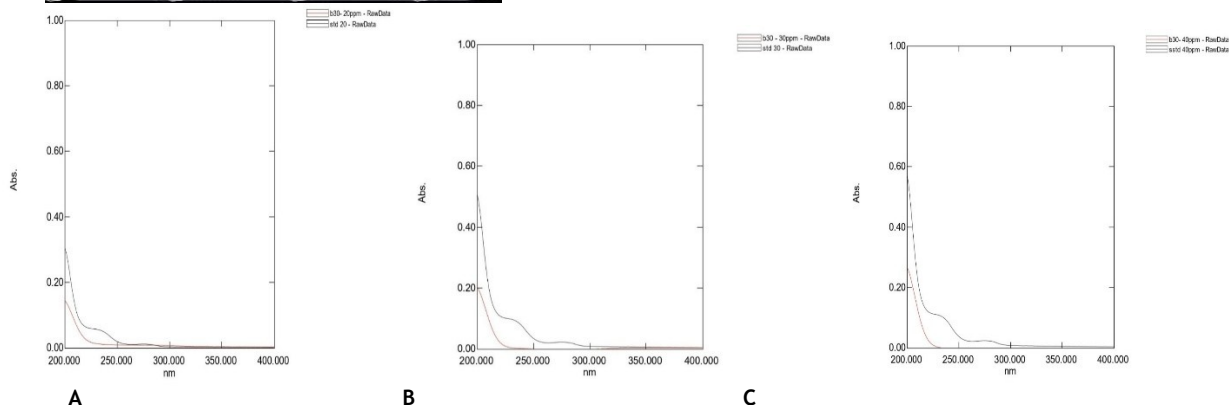


Fig. 2 A: UV Absorbance of Vildagliptin in Standard vs Bluetooth mode Day 30 at 20 µg/ml

Fig. 2 B: UV Absorbance of Vildagliptin in Standard vs Bluetooth mode Day 30 at 30 µg/ml

Fig. 2 C: UV Absorbance of Vildagliptin in Standard vs Bluetooth mode Day 30 at 40 µg/ml

Observation:

Table 1: Absorbance of Vildagliptin for Bluetooth mode Vs Standard

Conc. In (µg/ml)	Standard Absorbance at 210 nm	Mean of Absorbance at 210 nm of Standard	Absorbance at 210 nm of Bluetooth Mode	Standard Deviation (SD)	Standard Error (SE)	Correlation of Error
20	0.123	0.185	0.076	0.0010	0.0006	0.048
	0.124					
	0.125					
30	0.207	0.243	0.100	0.0010	0.0006	0.108
	0.208					
	0.209					
40	0.232	0.261	0.131	0.0010	0.0006	0.102
	0.233					
	0.234					

Flight mode Vs Standard:

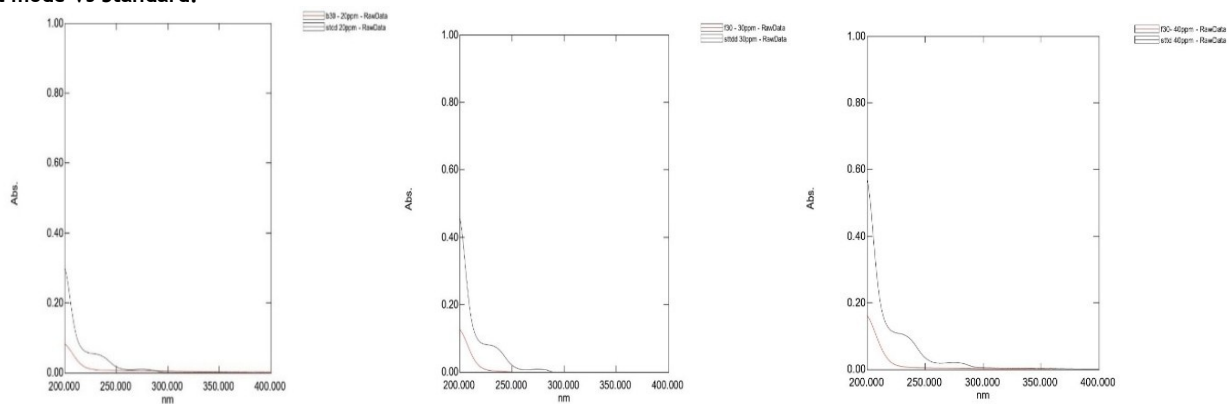


Fig. 1: Vildader 50mg - Vildagliptin Tablet

Following parameters are studied:

- 1) UV- Visible Spectrophotometric Analysis
- 2) FTIR Spectroscopy
- 3) HPLC Analysis
- 4) Differential Scanning Calorimetry
- 5) Animal Activity Study (Pharmacodynamic Evaluation)

Tablets were exposed to following mobile radiations modes:

1. Bluetooth mode
2. Flight mode

EXPERIMENTAL OBSERVATION:

- UV-Visible Spectroscopy:
Bluetooth mode vs Standard:

A

B

C

Fig. 3 A: UV Absorbance of Vildagliptin in Standard vs Flight mode Day 30 at 20 µg/ml

Fig. 3 B: UV Absorbance of Vildagliptin in Standard vs Flight mode Day 30 at 30 µg/ml

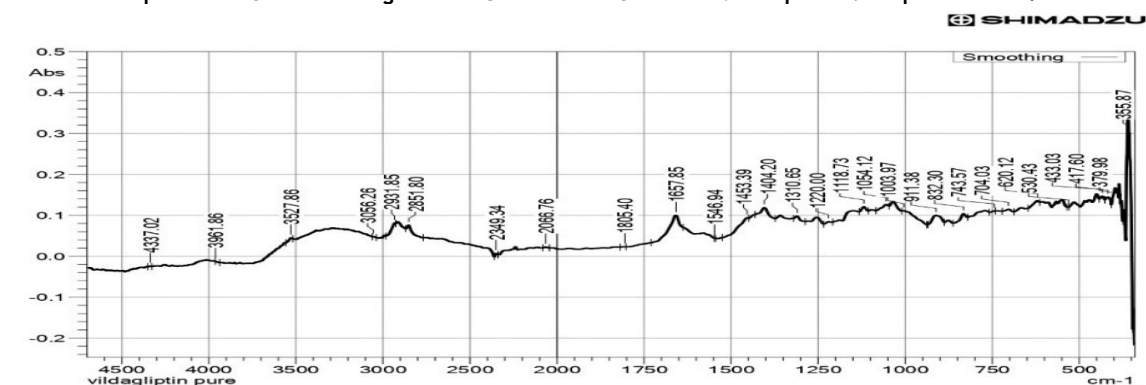
Fig. 3 C: UV Absorbance of Vildagliptin in Standard vs Flight mode Day 30 at 40 µg/ml

Observation:

Table 2: Absorbance of Vildagliptin for Flight Mode Vs Standard

Conc. In (µg/ml)	Standard Absorbance at 210 nm	Mean of Absorbance at 210 nm of Standard	Absorbance at 210 nm of Flight Mode	Standard Deviation (SD)	Standard Error (SE)	Correlation of Error
20	0.121	0.184	0.043	0.0010	0.0006	0.077
	0.120					
	0.119					
30	0.179	0.221	0.061	0.0010	0.0006	0.118
	0.180					
	0.178					
40	0.229	0.257	0.081	0.0010	0.0006	0.149
	0.231					
	0.230					

- FTIR Interpretation- Structural Degradation Over Time of Standard Non-Exposed Vs Exposed Tablet:



C:\YFTIR Scans PDF\Yabhi\Yvildagliptin pure.ispd
vildagliptin pure

FTIR Spectrum of Standard Vildagliptin

Fig. 4:



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vildagliptin 30 b

Fig. 5: FTIR Spectrum of Bluetooth Day 30 study

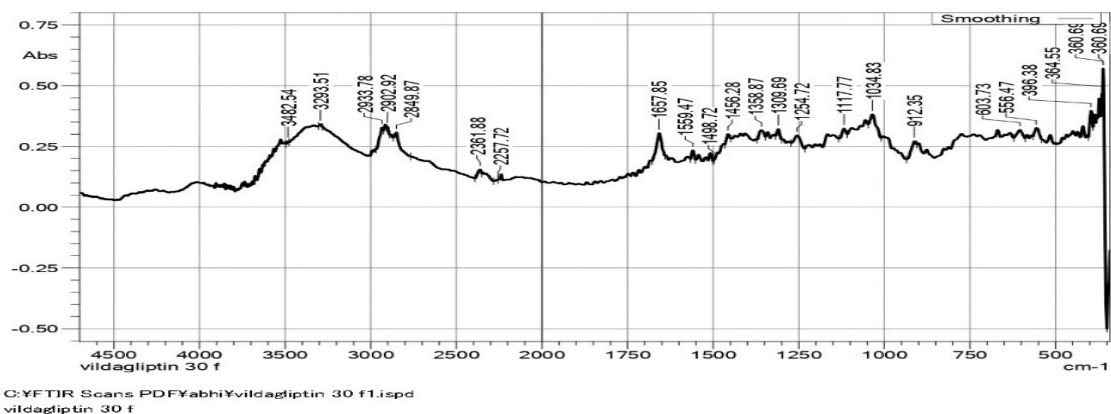


Fig. 6: FTIR Spectrum of Flight mode Day 30 study

Table 3: IR study

Functional Group	Standard (cm ⁻¹)	Standard Peaks (cm ⁻¹)	Bluetooth Mode (cm ⁻¹)	Flight Mode (cm ⁻¹)
N-H stretch (amine/amide)	3300-3600	3527.86	3335.94	3482.54
O-H stretch (alcohol)	3200-3400	3231.85	3207.40	3293.51
C=O stretch (amide)	1640-1690	1657.85	1656.87	1657.85
N-H bend (amide II)	1550-1620	1550.84	1557.49	1557.59
C-N stretch	1020-1350	1054.12	1056.04	1034.83
C-O stretch (alcohol)	1050-1150	1118.73	1117.75	1117.78

- HPLC analysis of Standard Non-Exposed Vs Exposed Tablet:

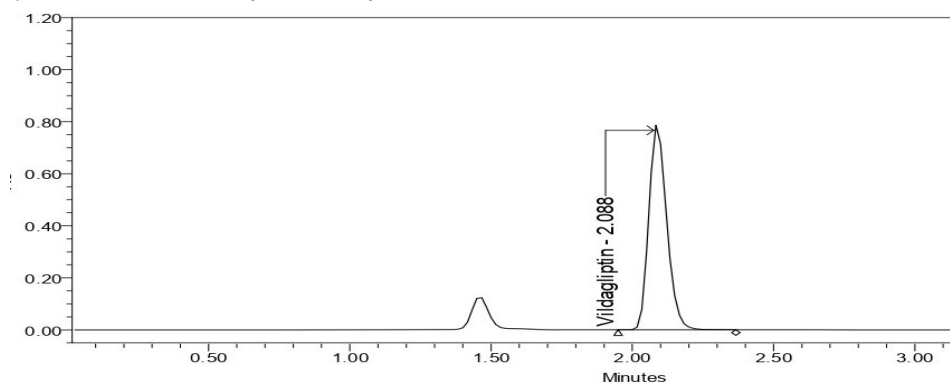


Fig. 7: HPLC Standard Vildagliptin

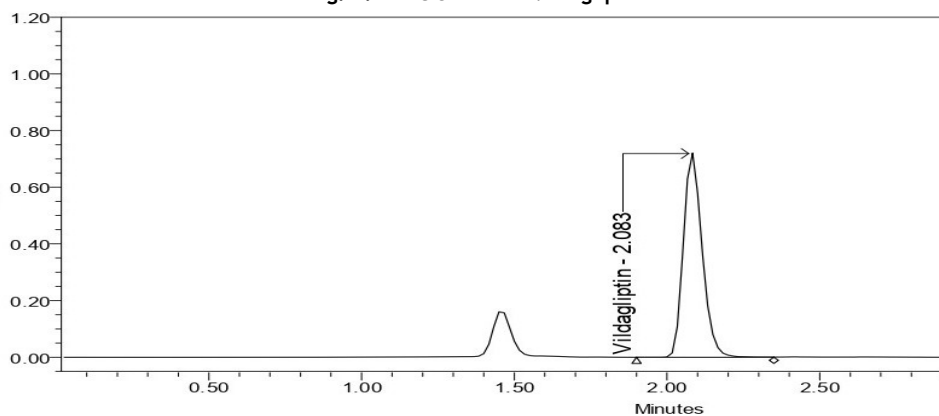


Fig. 8: HPLC Bluetooth Study

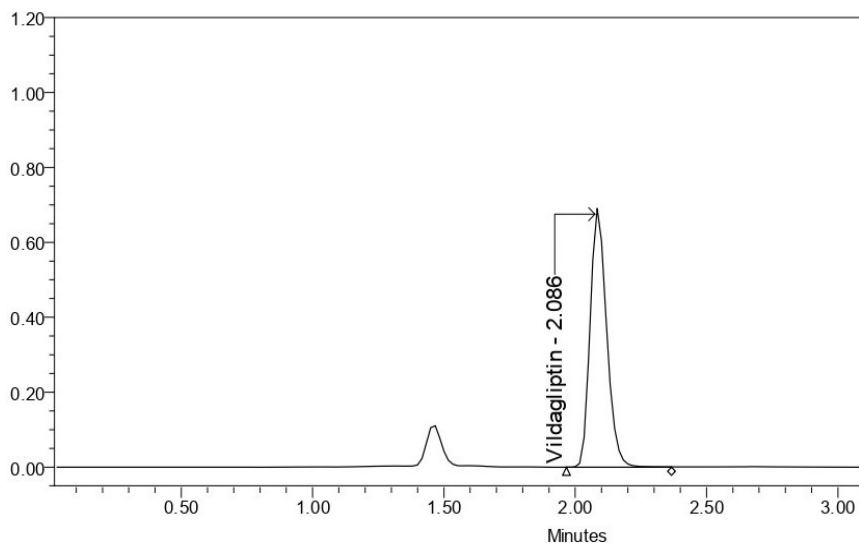


Fig. 9: HPLC Flight mode study

Table 4: HPLC Study

Day	Retention Time (min)	Peak Area	USP Tailing	USP Plate Count	% Degradation
Standard	2.088	3489462	1.19	4859	-
Bluetooth Mode	2.083	3087749	1.16	5314	11.51
Flight Mode	2.086	3026305	1.18	5014	13.27

- DSC Study of Standard Non-Exposed Vs Exposed Tablet:

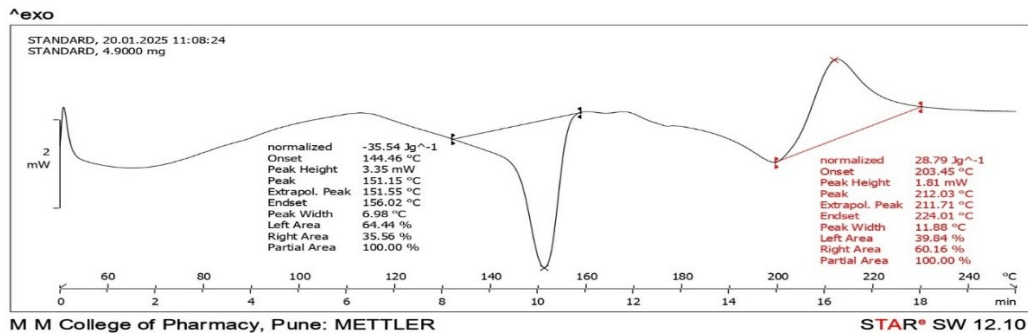


Fig. 10: DSC result of Standard Vildagliptin Tablet

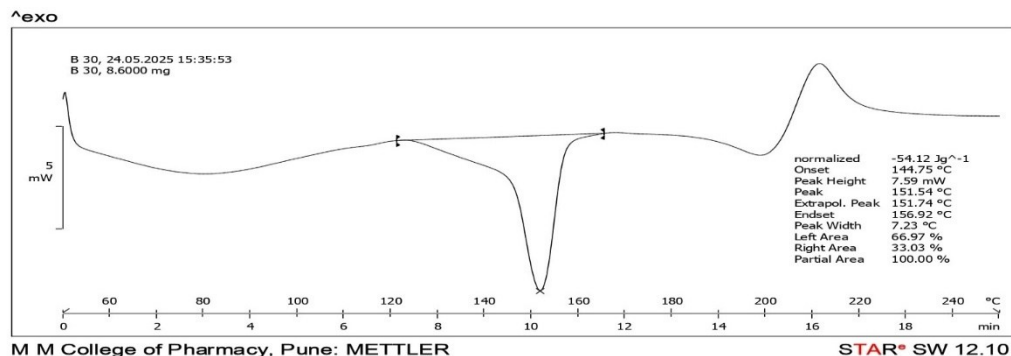


Fig. 11: DSC result of Bluetooth Mode Day

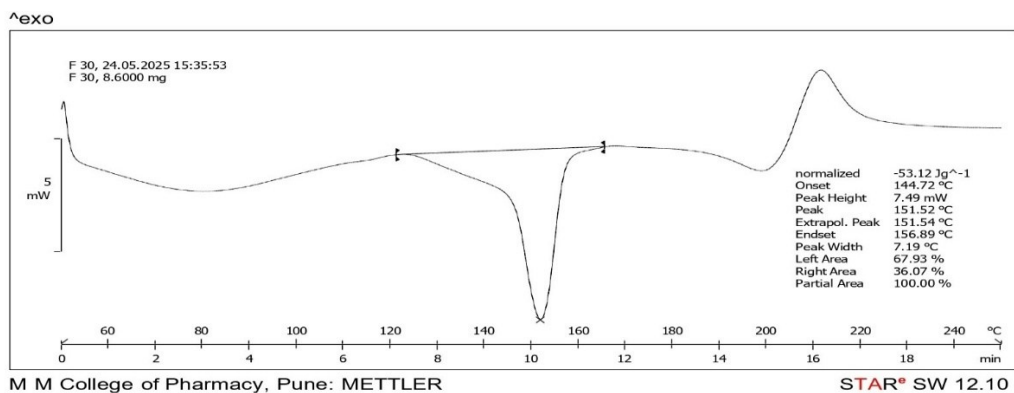


Fig. 12: DSC result of Flight Mode
Table 5: DSC Result of Bluetooth mode

Sample	Peak Temp (°C)	Peak Height (mW)	Normalized (Jg ⁻¹)	Onset (°C)	Endset (°C)	Peak Width (°C)	Interpretation
Standard	151.15 / 212.03	3.35 / 1.81	-35.54 / 28.79	144.46 / 203.45	156.02 / 224.01	6.98 / 11.88	No effect (reference)
Bluetooth Mode	151.54	7.59	-54.12	144.75	156.92	7.23	Major effect - Significant enthalpy rise and high peak intensity
Flight Mode	151.52	7.49	-53.12	144.72	156.89	7.19	Major effect - Confirmed sustained thermal degradation

- Animal Activity:**

The antidiabetic potential of Vildagliptin was evaluated using an Alloxan-induced diabetic model in Wistar rats. Diabetes was induced chemically, and animals showing elevated blood glucose levels were selected for the study. Vildagliptin was administered orally, and the animals were closely monitored for physiological

and biochemical changes. Blood glucose levels were measured at regular intervals to assess the therapeutic effectiveness of the drug. This model provided a reliable platform for studying the glucose-lowering effect and metabolic response to Vildagliptin in diabetic conditions.

Table 6: Animal Activity- Blood Glucose Level

Sr. No.	Group	Rat 1	Rat 2	Rat 3	Rat 4	Rat 5	Rat 6	Average
1	Normal Control	81	83	79	85	87	83	83
2	Induction Control	291	288	294	290	302	289	292.3
3	Standard	243	251	248	239	256	253	248.3
4	Test Group 1 - Bluetooth Mode:							
	0 th	295	293	297	302	308	304	299.83
	7 th	301	307	304	314	319	302	307.83
	14 th	308	311	309	310	313	310	316.16
5	Test Group 2 - Flight Mode							
	0 th	270	273	276	269	279	272	273.16

	7 th	278	276	279	274	285	276	278
	14 th	283	279	283	276	302	289	285.3

CONCLUSION

UV Spectroscopy: Absorbance values of Vildagliptin declined progressively over time, indicating degradation. Bluetooth mode resulted in more pronounced reduction than Flight mode, suggesting stronger destabilizing effects. **FTIR Analysis:** Functional group shifts (notably N-H and O-H stretching) indicated structural changes post-exposure. Bluetooth mode showed significant deviation from standard peaks by Day 30, highlighting possible breakdown of key chemical bonds. **HPLC Results:** Peak area analysis revealed time-dependent degradation. Bluetooth exposure caused up to 11.51% degradation, Flight mode up to 13.27%. Retention times and USP tailing factors remained within acceptable ranges, indicating consistent chromatographic performance. **DSC Results:** Endothermic peak shifts and rising enthalpy values confirmed thermal degradation of Vildagliptin over time. Bluetooth exposure showed the most significant changes, suggesting reduced thermal stability. **Animal Study:** Diabetic rats treated with radiation-exposed Vildagliptin showed higher blood glucose levels compared to those treated with standard tablets. Bluetooth mode exposure significantly reduced the drug's hypoglycemic effect, especially at 30 days.

This study confirms that electromagnetic radiation from mobile devices can affect the stability and therapeutic efficacy of Vildagliptin. Bluetooth exposure caused greater degradation compared to Flight mode. These findings underscore the need for protective packaging and EMR-aware storage guidelines for sensitive pharmaceuticals.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

REFERENCES

- Gupta, R. and Misra, A. 2007. Review: Type 2 diabetes in India: regional disparities. *The British Journal of Diabetes & Vascular Disease*. 7(1): 12-16. <https://doi.org/10.1177/14746514070070010301>
- Shah, V.N. and Mohan, V. 2015. Diabetes in India: what is different? *Current Opinion in Endocrinology, Diabetes & Obesity*. 22(4): 283-289. <https://doi.org/10.1097/med.0000000000000166>
- Wannamethee, S.G. 2004. Cardiovascular disease incidence and mortality in older men with diabetes and in men with coronary heart disease. *Heart*. 90(12): 1398-1403. <https://doi.org/10.1136/hrt.2003.026104>
- Mamoon, A. 2003. Biological potential hazards of electromagnetic fields: the case of mobile phones. *INV3-12*. <https://doi.org/10.1109/nrsc.2003.1217310>
- Elvers, H.-D., Jandrig, B., Grummich, K. and Tannert, C. 2009. Mobile phones and health: Media coverage study of German newspapers on possible adverse health effects of mobile phone use. *Health, Risk & Society*. 11(2): 165-179. <https://doi.org/10.1080/13698570902784273>
- Miller, A.B. 2022. Public Health Implications of Exposure to Wireless Communication Electromagnetic Fields. *CRC*. pp.79-96. <https://doi.org/10.1201/9781003201052-5>
- Verma, A. and Kumar, V. 2023. Electromagnetic Waves Effects on Biological Materials. pp.149-153. <https://doi.org/10.1109/cictn57981.2023.10140820>
- Grevisse, Y.R., Louis, K.N., Jean-Claude, B.M., Albert, L.A.T., Chris, K.I. and Marie Alice, T.N. 2023. Possible dangers of electromagnetic waves from cell phones and

relay antennas on human health in DRC: Effects, Risks, Health and Protection. *European Journal of – [details incomplete]*.

- Momale, A.V., Patil, A.P., Davala, N.C. and Pawar, S. 2024. Review on Analytical Methodology for Estimation of Vildagliptin & Metformin in Drug Substance, Pharmaceutical Formulations & Biological Matrices.
- Physicochemical Properties and Methods of Analysis of Vildagliptin - a comprehensive review documenting IR absorption bands of vildagliptin (3294, 2238, 1658 cm⁻¹, etc.) and describing applications of near IR reflection spectroscopy for quality control. *Journal of Chemical Health Risks*.
- Review of Analytical Method Development for Simultaneous Estimation of Vildagliptin. *African Journal of Biomedical Research*. Dec 2024.
- Review on Analytical Methodology for Estimation of Vildagliptin & Metformin. *Journal of Chemical Health Risks*. 2024.
- Differential Scanning Calorimetry: A Review. *Open Access Journals, RROJ*.
- Application of Modulated DSC (MDSC) in Pharma. *MDPI Review*.
- Parmar, D., Tiwari, N. and Patani, P. 2024. A Review of the Development of Analytical Methods for the Simultaneous Estimation and Validation of Vildagliptin. *African Journal of Biomedical Research*.
- Alkather, Z., Hailat, M., Al Shdefat, R. and Abu Dayyih, W. 2021. Development and Validation of HPLC Method for Five Gliptins in Pharmaceutical Dosage Forms. *Current Pharmaceutical Analysis*.
- Mohite, M.T., Sharma, P., Sharma, J., Chaudhari, P. and Kore, S. 2023. Impact of mobile radiations on gliclazide tablet formulation. *International Journal of Pharmaceutical Investigation*. 13(3): 471-475.