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# 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.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)

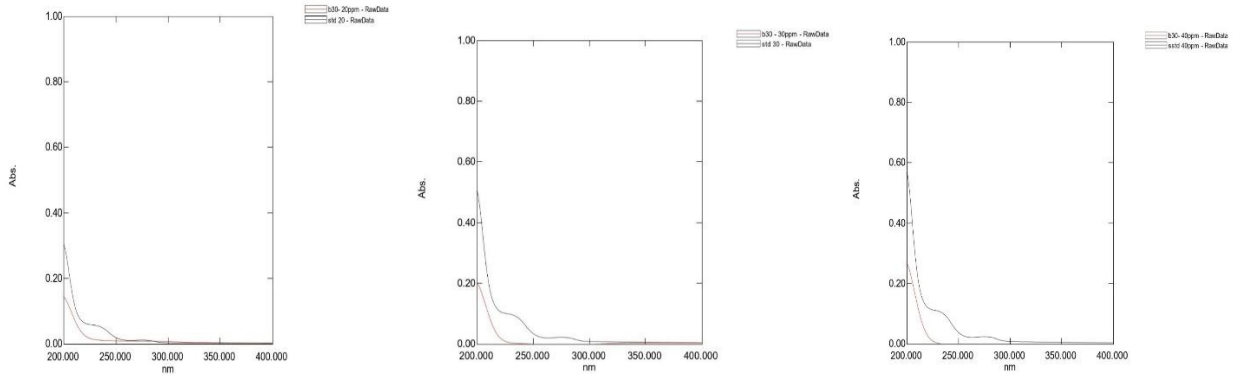
Tablets were exposed to following mobile radiations modes:

1. **Bluetooth mode**
2. **Flight mode**

**EXPERIMENTAL OBSERVATION:**

- **UV-Visible Spectroscopy:**

**Bluetooth mode vs Standard:**




**A** **B** **C**

**Fig. 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**

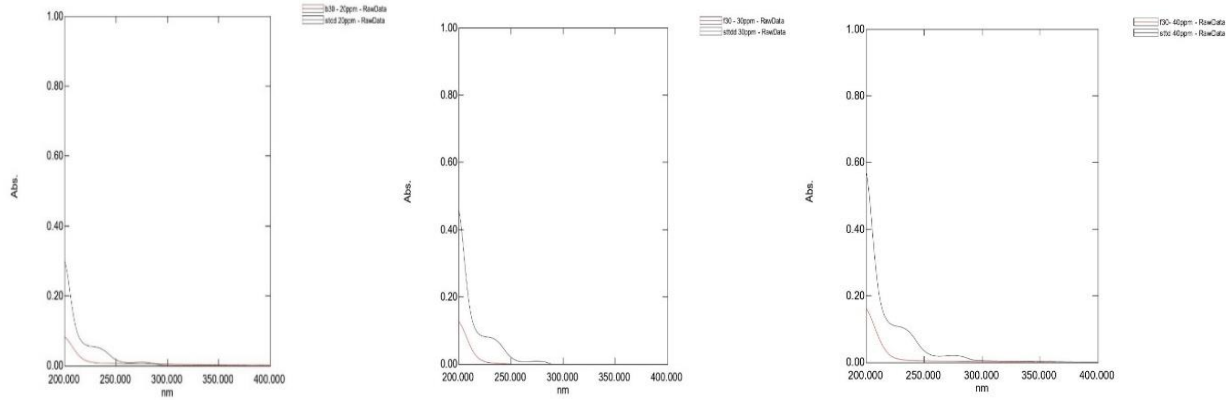
**Observation**:

**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:**




**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:**

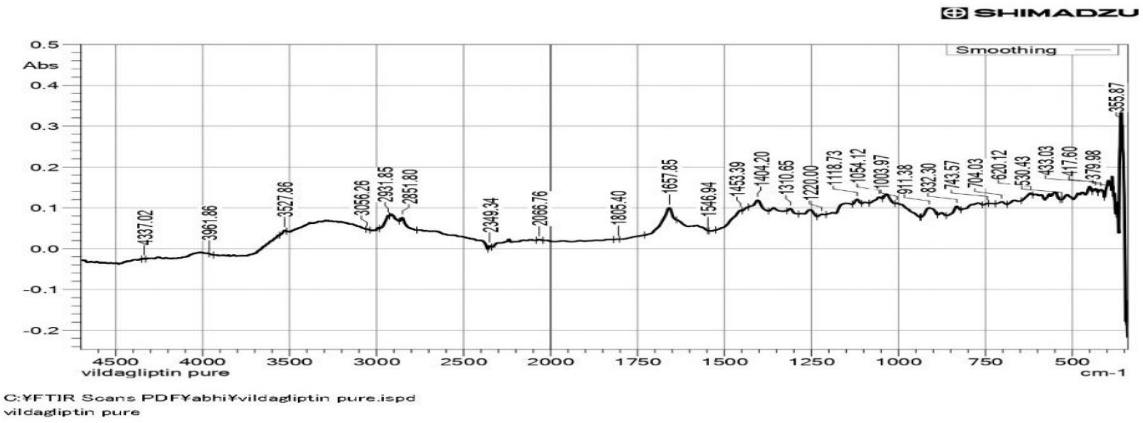



**Fig. 4: FTIR Spectrum of Standard Vildagliptin**

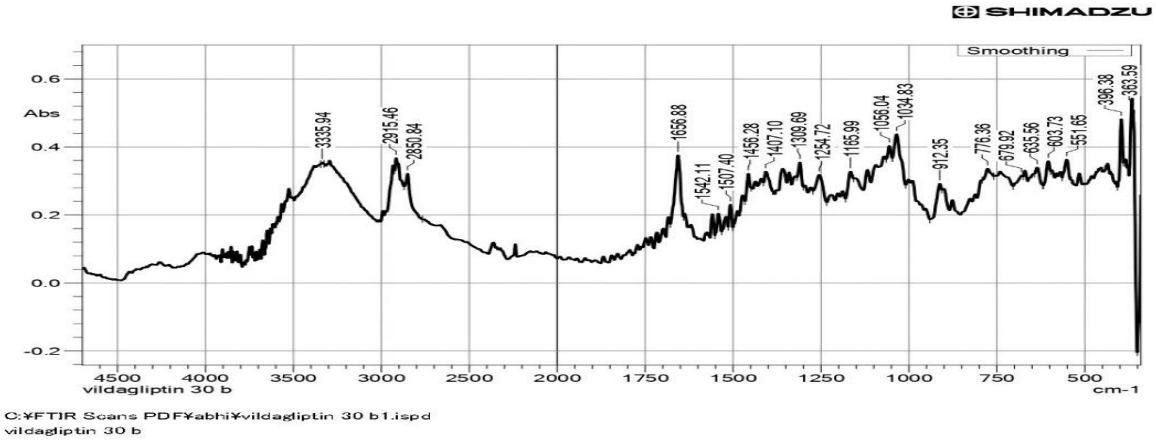



**Fig. 5: FTIR Spectrum of Bluetooth Day 30 study**

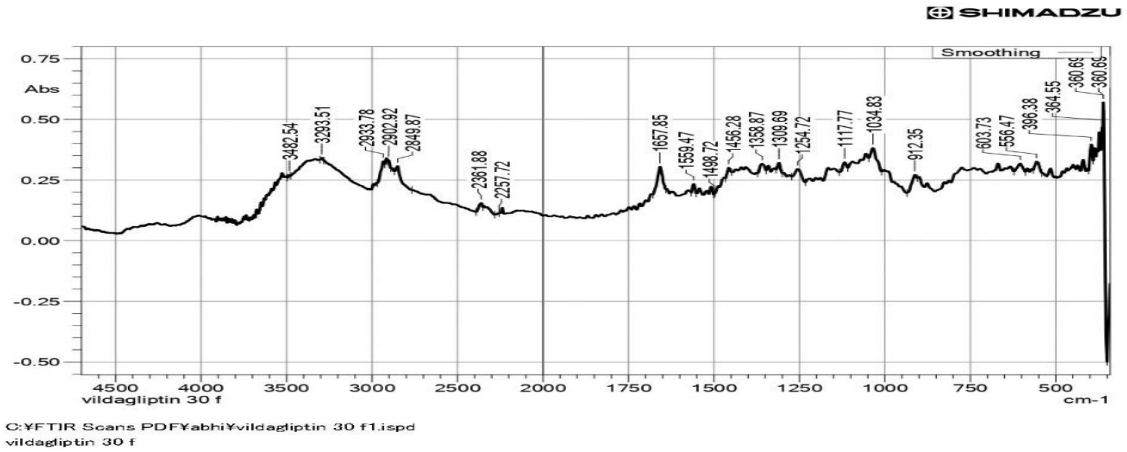



**Fig. 6: FTIR Spectrum of Flight mode Day 30 study**

**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:**

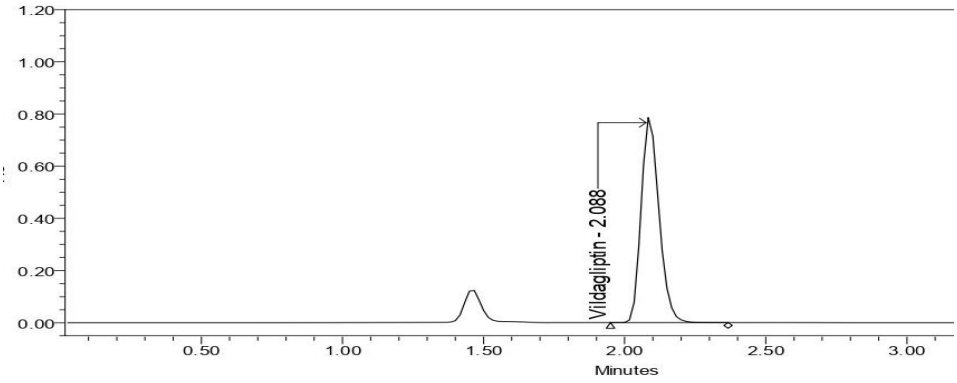



**Fig. 7: HPLC Standard Vildagliptin**

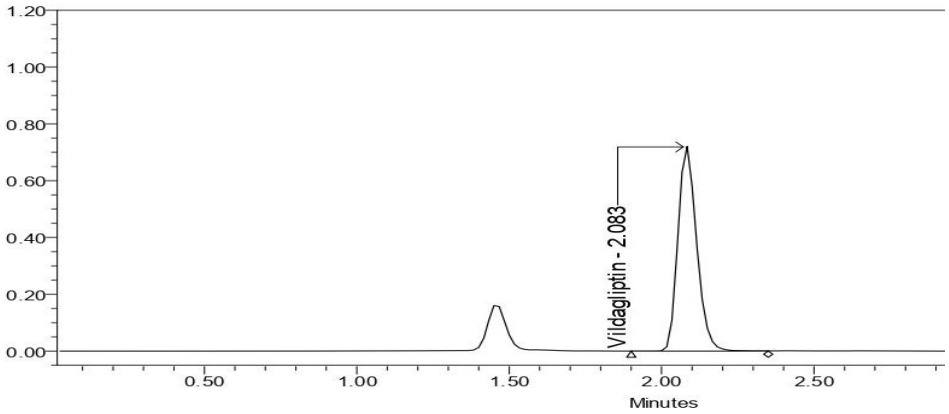



**Fig. 8: HPLC Bluetooth Study**

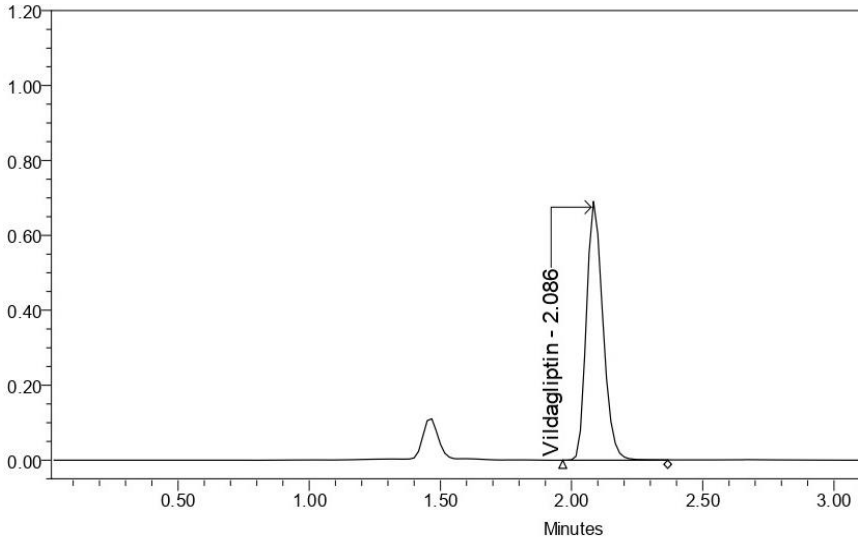



**Fig. 9: HPLC Flight mode study**

**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:**

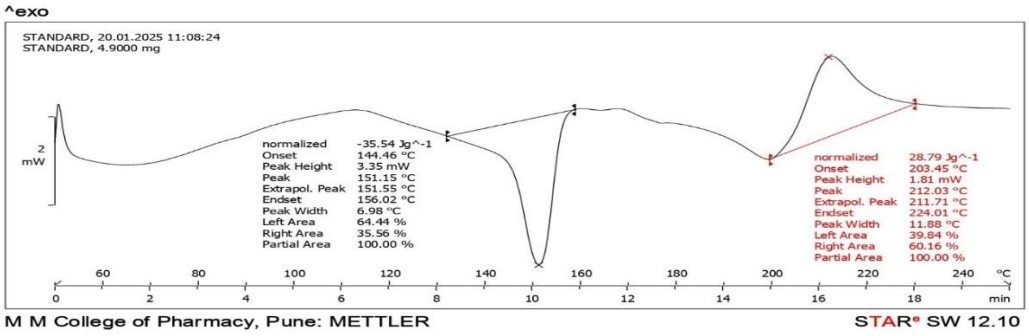



**Fig. 10: DSC result of Standard Vildagliptin Tablet**

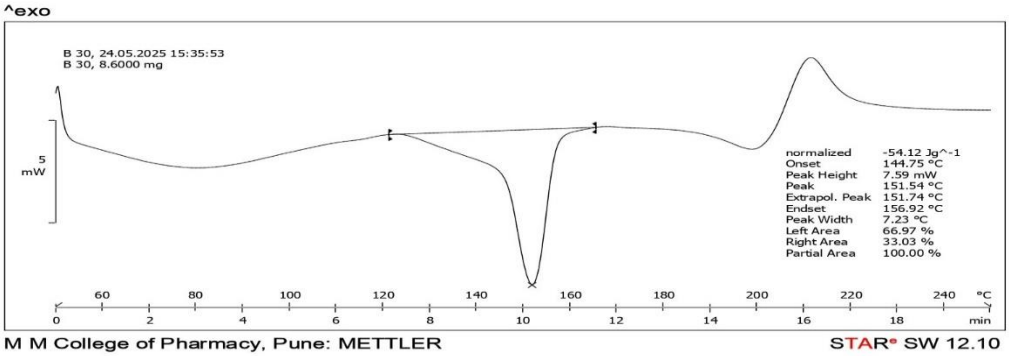



**Fig. 11: DSC result of Bluetooth Mode Day**

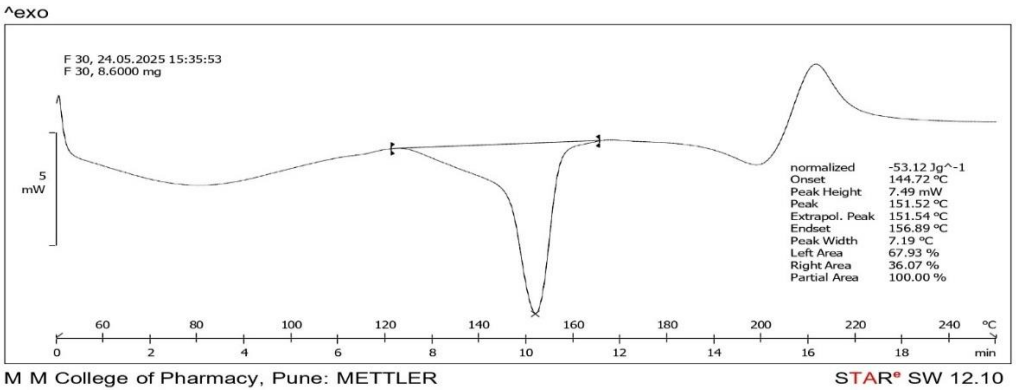



**Fig. 12: DSC result of Flight Mode**

**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.

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