QUANTITATIVE ESTIMATION OF TENELIGLIPTIN BY VALIDATED COLORIMETRIC AND FTIR SPECTROSCOPIC METHODS

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ABSTRACT
A simple sensitive and precise colorimetric method (method A) and FTIR spectroscopic method (method B) were developed for the estimation of teneligliptin in bulk drug as well as in pharmaceutical dosage form. Method A is based on the formation of an orange coloured complex of teneligliptin with 1, 10-phenanthroline in the presence of ferric chloride, which has absorption maximum at 424nm. Method B is based on rapid FTIR spectroscopy involving the measurement of the area of the infrared band corresponding to the C=O stretching centered at 1645cm⁻¹. The proposed methods are statistically validated and found to be useful for the routine determination of teneligliptin in tablets.

KEYWORDS: Teneligliptin, Colorimetry, FTIR, Tablets, Validation.

INTRODUCTION
Teneligliptin (TNG) is used to help control blood sugar levels in patients affected by type -2 diabetes.[1,2] Teneligliptin works by inhibiting the activity of certain enzymes known as DPP-4. This enzyme is responsible for degrading ingredients such as GLP-1(Glucagon-Like peptide 1), which are needed by the body to control blood sugar. Blocking the action of DPP-4 leads to increased GLP-1 levels. GLP-1 helps to increase the release of insulin, which in turn leads to lowered blood glucose levels, thereby making this medicine effective in controlling type-2 diabetes.[3,4] Chemically it is [(2S, 4S)-4-(3-Methyl-1-phenyl-1H-pyrazol-5-yl)-1-piperazinyl]-2-pyrrolidinyl]-3-thiazolidinylmethanone hydrobromide.[5] The
available methods for analysis of the drug in biological fluids and pharmaceutical products are RP-HPLC method\textsuperscript{[6,7]} LC-MS method\textsuperscript{[8]} and HPTLC method.\textsuperscript{[9]}

The present work deals with the estimation of TNG in tablets by colorimetric and FTIR spectroscopic methods. In the colorimetric method (Method A), TNG is first condensed with 1, 10-phenanthroline and ferric chloride to form an orange chromogen, which absorbs intensively at 424nm. FTIR Spectroscopic method (Method B) is based on the measurement of the area of the infrared band corresponding to the C=O stretching centered at 1645cm\textsuperscript{-1}. The methods are alternative and comparable in specificity and accuracy to chromatography methods, which although highly specific and accurate, are more time consuming, performed in several steps and are rather expensive.

**MATERIALS AND METHODS**

**Instrumentation:** All spectral and absorbance measurements were made on UV-Vis Spectrophotometer-1900s for method A and FTIR model ABB 3000 for method B.

**Reagents**
1. 1, 10-phenanthroline (0.2%w/v)
2. Ethanol (95% w/v)
3. Carbon tetrachloride
4. Ferric chloride (5% w/v).

All reagents were used of analytical grade.

**Preparation of standard solution**
A 1 mg/ml stock solution of TNG was prepared by dissolving 100 mg of drug in 100 ml of ethanol.

**Sample preparation**
Twenty tablets were weighed and powdered. A quantity equivalent to 100mg of TNG was weighed accurately, transferred to a beaker, dissolved in ethanol, filtered through whatmann filter paper No. 1 into a 100 ml volumetric flask and made up to volume with ethanol to get a concentration of 1mg/ml.
Assay

Method A
Appropriate aliquots of TNG were pipetted out into a series of 25 ml volumetric flasks. To each flask 2 ml of 1, 10-phenanthroline and 2 ml ferric chloride reagent was added, mixed thoroughly and made up to volume with ethanol. The $\lambda_{\text{max}}$ of the orange coloured chromogen was found to be 424 nm (Figure-1). The absorbance of the orange coloured chromogen was measured at 424 nm against the reagent blank. The orange chromogen was stable for more than 3 hours. The analytical curve was constructed by plotting concentration versus absorbance.

![Figure 1: $\lambda_{\text{max}}$ of the orange chromogen by Method A.](image)

Method B
The stock solution was diluted suitably with carbon tetrachloride to give a series of concentration ranging from 20-100 µg/ml of TNG. The IR spectrum was recorded for the various concentrations. The absorbance of the band due to C=O stretching at 1645 cm$^{-1}$ was measured. All the determinations were conducted in triplicate. The IR spectrum of TNG is shown in Figure-1. The calibration curve of TNG was obtained by plotting the peak area (C=O stretching centred at 1645 cm$^{-1}$) versus concentration.
Sample Analysis
Pharmaceutical formulation of TNG was successfully analyzed by the proposed methods. Appropriate aliquots were subjected to the above methods and the amount of the TNG was determined from the calibration curves. The results of sample analysis are furnished in table 2.

RESULTS AND DISCUSSION
The optical characteristics such as absorption maxima, Beer’s law limits, Molar absorptivity and Sandell’s sensitivity are furnished in table 1. The regression characteristics like slope (b), intercept (a), correlation coefficient (r), percent relative standard deviation (%RSD) and standard error (SE) obtained from different concentrations were calculated and the results are summarized in table 1.

To study the accuracy and reproducibility of the proposed methods, recovery experiments were carried out by adding a known amount of drug to pre-analyzed sample and the percentage recovery was calculated. The results are furnished in table 2. The results indicate that there are no interference of other ingredients present in the formulation. Thus, the proposed methods are simple, sensitive, precise, accurate and reproducible and useful for the routine determination of TNG in bulk drug and its pharmaceutical dosage form.
Table 1: Optical characteristics, Precision and Accuracy of the proposed methods.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Method A</th>
<th>Method B</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda_{\text{max}}$/Stretching</td>
<td>424nm</td>
<td>C=O stretching at 1645 cm$^{-1}$</td>
</tr>
<tr>
<td>Linearity Range (µg/ml)</td>
<td>0.2 -1.6</td>
<td>20-100</td>
</tr>
<tr>
<td>Molar absorptivity (Lmol$^{-1}$cm$^{-1}$)</td>
<td>43.01x10$^3$</td>
<td>-----</td>
</tr>
<tr>
<td>Sandell’s sensitivity (µg/cm²/0.001 absorbance unit)</td>
<td>0.009083</td>
<td>-----</td>
</tr>
<tr>
<td>Regression equation(*y)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope (b)</td>
<td>0.6706</td>
<td>0.44995</td>
</tr>
<tr>
<td>Intercept (a)</td>
<td>0.1426</td>
<td>0.1477</td>
</tr>
<tr>
<td>Correlation co-efficient (r)</td>
<td>0.9989</td>
<td>0.9999</td>
</tr>
<tr>
<td>% RSD</td>
<td>0.1169</td>
<td>0.155</td>
</tr>
<tr>
<td>Standard error (SE)</td>
<td>0.0947</td>
<td>0.0139</td>
</tr>
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</table>

$y = a+bc$ where $c$ is the concentration of TNG in µg/ml.

Table 2: Assay and recovery of TNG in the dosage form (tablets).

<table>
<thead>
<tr>
<th>Method</th>
<th>Labelled amount (mg)</th>
<th>Amount obtained (mg)*</th>
<th>Percentage recovery**</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>20.00</td>
<td>19.83</td>
<td>100.03</td>
</tr>
<tr>
<td>B</td>
<td>20.00</td>
<td>19.97</td>
<td>100.01</td>
</tr>
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</table>

*Average of six determinations **Average of three determinations.

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