AN EFFICIENT TWO-STEP SYNTHESIS OF 4-METHYL-1,2,3,5,6,10b-HEXAHYDROPYRIMIDINO[5,4-c]QUINOLINE-2,5-DIONES VIA BIGINELLI REACTION

Lhassane Ismaili, a Sophie Ubaldi, b Jean-Francois Robert, a Alain Xicluna, a Bernard Refouvelet* a

(a) Equipe Sciences séparatives et Biopharmaceutique (2SB), Laboratory of medicinal chemistry, Faculty of Pharmacy, 4, place Saint Jacques - 25030 Besançon Cedex, France
(b) SERAC / UT LCE, Faculty of Sciences – Building O -16, route de Gray - 25030 Besançon Cedex, France
e-mail : bernard.refouvelet@univ-fcomte.fr

Abstract - An efficient two-step synthesis of 4-methyl-1,2,3,5,6,10b-hexahydropirimido[5,4-c]quinoline-2,5-diones is presented. It consists of the reactions of appropriate aldehyde, urea and ethyl acetoacetate according to Biginelli reaction, followed by cyclisation with ammonia.

INTRODUCTION

Within the framework of the prevention of the ageing, a lot of heterocyclic compounds either natural (phytoestrogens) or obtain by synthesis, having coumarin or quinoline rings, was studied for their biological activity. They are used specialty as antioxidants like in Alzheimer disease by chelating iron or copper such as clioquinol1,2 or as antagonists of the human oestrogenics receptors.3-5 After first biological studies realized in our laboratory4-6 on new compounds with quinoline and coumarin structures, we intended to synthesize new potential antioxidants having quinoline ring using the Biginelli reaction.

RESULTS AND DISCUSSION

The Biginelli reaction is one of the multicomponent reactions (MCRs) and the most often used for the synthesis of 3,4-dihydropyrimidin-2-(1H)ones. In general, Biginelli reaction is simple one pot using
The interest of this reaction is that it allows obtaining directly the precursors to the wished molecules. In this paper, we report the synthesis of 4-methyl 1,2,3,5,6,10b-hexahydropyrimido[5,4-c]quinoline-2,5-diones in two steps. The first step (Scheme 1) consists in a Biginelli reaction and the second step is the cyclisation in the presence of ammonia. As shown in Scheme 1, the condensation of the derivatives of 2-chlorobenzaldehyde, ethyl acetoacetate, urea and its derivatives and boric acid according to Biginelli reaction gives ethyl 4-phenyl-6-methyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylates. For the compounds prepared with monosubstituted urea, we obtained exclusively the regioisomer N1-substituted 4-phenyl-6-methyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate according to the mechanisms and the regiochemistry described by Sweet and Fissekis or described by Kappe. All the compounds summarized in Table 1 were obtained in moderate to good yields ranging from 48 to 94%. All these products were isolated from reaction mixture by recrystallization from ethanol, and their structures were characterized by $^1$H NMR, IR spectra and elementary analysis.

![Scheme 1](image)

**Table 1.** Synthesis of 3,4-dihydropyrimidin-2(1H)ones (4a-i)

<table>
<thead>
<tr>
<th>Compounds</th>
<th>R1</th>
<th>R2</th>
<th>Yields %</th>
</tr>
</thead>
<tbody>
<tr>
<td>4a</td>
<td>H</td>
<td>CH$_3$</td>
<td>70</td>
</tr>
<tr>
<td>4b</td>
<td>H</td>
<td>C$_2$H$_5$</td>
<td>73</td>
</tr>
<tr>
<td>4c</td>
<td>6-F</td>
<td>C$_2$H$_5$</td>
<td>75</td>
</tr>
<tr>
<td>4d</td>
<td>5-NO$_2$</td>
<td>CH$_3$</td>
<td>48</td>
</tr>
<tr>
<td>4e</td>
<td>3-Cl</td>
<td>C$_2$H$_5$</td>
<td>56</td>
</tr>
<tr>
<td>4f</td>
<td>6-Cl</td>
<td>CH$_3$</td>
<td>88</td>
</tr>
<tr>
<td>4g</td>
<td>3-Cl</td>
<td>CH$_3$</td>
<td>90</td>
</tr>
<tr>
<td>4h</td>
<td>H</td>
<td>H</td>
<td>94</td>
</tr>
<tr>
<td>4i</td>
<td>4-Cl</td>
<td>H</td>
<td>69</td>
</tr>
</tbody>
</table>
Scheme 2 reports cyclisation procedure of 4a-i to new compounds (5a-g). This cyclisation is realised with ammonia under pressure except for compounds 4h and 4i with no substituted urea.

![Scheme 2 Diagram]

According to the literature\textsuperscript{16} the unreactivity of the ester group may be attributed to its strong conjugation with the lone pair of N-1 unsubstituted derivatives. The products 5a-g obtained with good yields from 70\% to 90\% are presented in the (Table 2).

<table>
<thead>
<tr>
<th>Compounds</th>
<th>R\textsubscript{1}</th>
<th>R\textsubscript{2}</th>
<th>Yields %</th>
</tr>
</thead>
<tbody>
<tr>
<td>5a</td>
<td>H</td>
<td>CH\textsubscript{3}</td>
<td>70</td>
</tr>
<tr>
<td>5b</td>
<td>H</td>
<td>C\textsubscript{2}H\textsubscript{5}</td>
<td>73</td>
</tr>
<tr>
<td>5c</td>
<td>10-F</td>
<td>C\textsubscript{2}H\textsubscript{5}</td>
<td>80</td>
</tr>
<tr>
<td>5d</td>
<td>9-NO\textsubscript{2}</td>
<td>CH\textsubscript{3}</td>
<td>85</td>
</tr>
<tr>
<td>5e</td>
<td>7-Cl</td>
<td>C\textsubscript{2}H\textsubscript{5}</td>
<td>73</td>
</tr>
<tr>
<td>5f</td>
<td>10-Cl</td>
<td>CH\textsubscript{3}</td>
<td>90</td>
</tr>
<tr>
<td>5g</td>
<td>7-Cl</td>
<td>CH\textsubscript{3}</td>
<td>81</td>
</tr>
</tbody>
</table>

All new products were characterized by \textsuperscript{1}H NMR, IR spectra and elementary analysis. The \textsuperscript{1}H NMR spectra of compounds 5a-g show the disappearance of the triplet and quartet of ester group and appearance of additional NH signal.

**MATERIALS AND METHODS**

All compounds were characterized using the methods of elementary analyses, IR spectroscopy and NMR spectroscopy. Infrared spectra were recorded on a Shimadzu FTIR-8201 PC spectrometer in KBr (\(\nu\) in cm\(^{-1}\)). Proton NMR spectra were recorded on a Bruker AC 300 spectrometer. Chemical shift values and IR data for all compounds are summarized in the experimental part and in agreement with the proposed structures.
Melting points (mp) were obtained with a kofler and were not corrected. All reactions were monitoring with Thin Layer Chromatography (TLC) and carried out on Alugram Sil G/UV_{254} plate with appropriate solvents. Microanalyses were carried out by the service Central d’Analyses. Centre National de la Recherche Scientifique, Vernaison, France.

**EXPERIMENTAL**

**Synthesis of Ethyl 4-(2-Chlorophenyl)-1,6-dimethyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate (4a).**

A solution of o-chlorobenzaldehyde (3 mmol), ethyl acetoacetate (3 mmol), urea (3.6 mmol) and H_{3}BO_{3} (0.6 mmol), in glacial acetic acid (10 mL) is heated at 100°C, while stirring for 2h. Then it is cooled to rt, and poured into ice water (50 mL). The product collected by filtration was recrystallised from EtOH (95%), to give the pure product, 4a in 70% yield, mp 215°C, \( \nu(C=O) \) ester 1708, \( \nu(C=O) \) amide 1615, \( \nu(NH) \) 2990. \(^1\)H NMR (DMSO-\(d_6\)) 1.15 ppm (3H, t, \( J = 7.1 \) Hz, CH\(_3\) ester), 2.6 ppm (3H, s, CH\(_3\)), 3.2 ppm (3H, s, N-CH\(_3\)), 3.9 ppm (2H, q, \( J = 7.1 \) Hz, CH\(_2\) ester) 5.7 ppm (1H, d, \( J = 2.9 \) Hz, CH), 7.3-7.5 ppm (4H, m, aromH), 7.9 ppm (1H, s, NH). Anal. Calcd for C\(_{15}\)H\(_{17}\)N\(_2\)O\(_3\)Cl: C, 58.35; H, 5.55; Cl, 11.48; N, 9.07. Found: C, 58.24; H, 5.59; Cl, 11.49; N, 9.12.

**Ethyl 4-(2-Chlorophenyl)-1-ethyl-6-methyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate (4b).**

Compound 4b was prepared with the same procedure as 4a in 52 % yield, mp 210°C, \( \nu(C=O) \) ester 1705, \( \nu(C=O) \) amide 1670, \( \nu(NH) \) 3300. \(^1\)H NMR (DMSO-\(d_6\)) 1.1 ppm (3H, t, \( J = 7.1 \) Hz, CH\(_3\) ethyl), 1.2 ppm (3H, t, \( J = 7.0 \) Hz, CH\(_3\) ester), 2.6 ppm (3H, s, CH\(_3\)), 3.8 ppm (1H, m, CH ethyl), 3.9 ppm (1H, m, CH ethyl), 3.95 ppm (2H, q, \( J = 7.1 \) Hz, CH\(_2\) ester), 5.7 ppm (1H, d, \( J = 2.9 \) Hz, CH), 7.3-7.4 ppm (4H, m, aromH), 7.9 ppm (1H, s, NH). Anal. Calcd for C\(_{16}\)H\(_{19}\)N\(_2\)O\(_3\)Cl: C, 59.54; H, 5.93; Cl, 10.98; N, 8.68. Found: C, 60.03; H, 5.87; Cl, 10.92; N, 8.60.

**Ethyl 4-(2-Chloro-6-fluorophenyl)-1-ethyl-6-methyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate (4c).**

Compound 4c was prepared with the same procedure as 4a in 75 % yield, mp 158°C, \( \nu(C=O) \) ester 1703, \( \nu(C=O) \) amide 1670, \( \nu(NH) \) 3342. \(^1\)H NMR (DMSO-\(d_6\)) 1.0 ppm (3H, t, \( J = 7.0 \) Hz, CH\(_3\) ethyl), 1.2 ppm (3H, t, \( J = 7.1 \) Hz, CH\(_3\) ester), 2.6 ppm (3H, s, CH\(_3\)), 3.7 ppm (1H, m, CH ethyl), 3.8 ppm (1H, m, CH ethyl), 3.9 ppm (2H, q, \( J = 7.1 \) Hz, CH\(_2\) ester), 5.7 ppm (1H, d, \( J = 3.1 \) Hz, CH), 7.2-7.4 ppm (2H, m, aromH), 7.5 ppm (1H, m, aromH), 8 ppm (1H, s, NH). Anal. Calcd for C\(_{16}\)H\(_{18}\)N\(_2\)O\(_3\)ClF: C, 56.39; H, 5.32; Cl, 10.40; F, 5.58; N, 8.22. Found: C, 56.42; H, 5.27; Cl, 10.37; F, 5.52; N, 8.27.
Ethyl 4-(2-Chloro-5-nitrophenyl)-1,6-dimethyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate (4d).

Compound 4d was prepared with the same procedure as 4a in 48 % yield, mp 128°C, v(C=O) ester 1685, v(C=O) amide 1631, v(NH) 3213. \(^1\)H NMR (DMSO-\(d_6\)) 0.9 ppm (3H, t, J = 7.0 Hz, CH\(_3\) ester), 2.6 ppm (3H, s, CH\(_3\)), 3.15 ppm (3H, s, N-CH\(_3\)), 3.9 ppm (2H, q, J = 7.0 Hz, CH\(_2\) ester) 5.7 ppm (1H, d, J = 3.0 Hz, CH), 7.8 ppm (1H, d, J = 8.6 Hz, aromH), 8.1 ppm (1H, s, NH) 8.2 ppm (2H, m, aromH). Anal. Calcd for C\(_{15}\)H\(_{16}\)N\(_3\)O\(_5\)Cl: C, 50.93; H, 4.56; Cl, 10.02; N, 11.88. Found: C, 50.85; H, 4.59; Cl, 10.09; N, 11.95.

Ethyl 4-(2,3-Dichlorophenyl)-1-ethyl-6-methyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate (4e).

Compound 4e was prepared with the same procedure as 4a in 56 % yield, mp 116°C, v(C=O) ester 1678, v(C=O) amide 1624, v(NH) 3344. \(^1\)H NMR (DMSO-\(d_6\)) 1.0 ppm (3H, t, J = 7.1 Hz, CH\(_3\) ethyl), 1.2 ppm (3H, t, J = 7.0 Hz, CH\(_3\) ester), 2.5 ppm (3H, s, CH\(_3\)), 3.7 ppm (1H, m, CH ethyl), 3.8 ppm (1H, m, CH ethyl), 3.9 ppm (2H, q, J = 7.0 Hz,CH\(_2\) ester) 5.6 ppm (1H, d, J = 3.0 Hz, CH), 7.3-7.4 ppm (2H, m, aromH), 7.6 ppm (1H, d, J = 8.9 Hz, aromH), 7.9 ppm (1H, s, NH). Anal. Calcd for C\(_{16}\)H\(_{18}\)N\(_2\)O\(_3\)Cl\(_2\): C, 53.79; H, 5.08; Cl, 19.85; N, 7.84. Found: C, 53.75; H, 5.12; Cl, 19.77; N, 7.88.

Ethyl 4-(2,6-Dichlorophenyl)-1,6-dimethyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate (4f).

Compound 4f was prepared with the same procedure as 4a in 88 % yield, mp 130°C, v(C=O) ester 1683, v(C=O) amide 1630, v(NH) 3322. \(^1\)H NMR (DMSO-\(d_6\)) 0.9 ppm (3H, t, J = 7.0 Hz, CH\(_3\) ester), 2.4 ppm (3H, s, CH\(_3\)), 3.2 ppm (3H, s, N-CH\(_3\)), 3.9 ppm (2H, q, J = 7.0 Hz, CH\(_2\) ester); 6.2 ppm (1H, d, J = 3.0 Hz, CH), 7.2-7.6 ppm (3H, m, aromH), 7.8 ppm (1H, s, NH). Anal. Calcd for C\(_{15}\)H\(_{16}\)N\(_2\)O\(_3\)Cl\(_2\): C, 52.49; H, 4.70; Cl, 20.66; N, 8.16. Found: C, 52.34; H, 4.74; Cl, 20.48; N, 8.22.

4-(2,3-Dichlorophenyl)-1,6-dimethyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate (4g).

Compound 4g was prepared with the same procedure as 4a in 90 % yield, mp 118°C, v(C=O) ester 1672, v(C=O) amide 1621, v(NH) 3350. \(^1\)H NMR (DMSO-\(d_6\)) 0.9 ppm (3H, t, J = 7.1 Hz, CH\(_3\) ester), 2.5 ppm (3H, s, CH\(_3\)), 3.1 ppm (3H, s, N-CH\(_3\)), 3.9 ppm (2H, q, J = 7.0 Hz, CH\(_2\) ester); 5.6 ppm (1H, d, J = 3.2 Hz, CH), 7.2-7.5 ppm (3H, m, aromH), 7.9 ppm (1H, s, NH). Anal. Calcd for C\(_{15}\)H\(_{16}\)N\(_2\)O\(_3\)Cl\(_2\): C, 52.49; H, 4.70; Cl, 20.66; N, 8.16. Found: C, 52.37; H, 4.73; Cl, 20.69; N, 8.19.

Ethyl 4-(2-Chlorophenyl)-6-methyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate (4h).
Compound 4h was prepared with the same procedure as 4a in 94% yield, mp 215°C, ir ν(C=O) ester 1690, ν(NH) 3360. 1H NMR (DMSO-d6) 1.1 ppm (3H, t, J = 7.1 Hz, CH3 ester), 2.3 ppm (3H, s, CH3), 3.9 ppm (2H, q, J = 7 Hz, CH2 ester); 5.6 ppm (1H, d, J = 3.0 Hz, CH), 7.1-7.2 ppm (4H, m, aromH), 7.7 ppm (1H, s, NH), 9.3 ppm (1H, s, NH). Anal. Calcd for C14H15N2O3Cl: C, 57.05; H, 5.13; Cl, 12.03; N, 9.50. Found: C, 57.11; H, 5.11; Cl, 11.97; N, 9.45.

Ethyl 4-(2,4-Dichlorophenyl)-6-methyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate (4i).
Compound 4i was prepared with the same procedure as 4a in 69% yield, mp 249°C, ir ν(C=O) ester 1699, ν(NH) 3415. 1H NMR (DMSO-d6) 1 ppm (3H, t, J = 7.0 Hz, CH3 ester), 2.3 ppm (3H, s, CH3), 3.9 ppm (2H, q, J = 7.1 Hz, CH2 ester); 5.6 ppm (1H, d, J = 3.0 Hz, CH), 7.3-7.5 ppm (3H, m, aromH), 7.8 ppm (1H, s, NH), 9.3 ppm (1H, s, NH). Anal. Calcd for C14H14N2O3Cl2: C, 51.08; H, 4.29; Cl, 21.54; N, 8.51. Found: C, 51.12; H, 4.27; Cl, 21.49; N, 8.62.

3,4-Dimethyl-1,2,3,5,6,10b-hexahydropyrimido[5,4-c]quinoline-2,5-dione (5a).
A solution of o-chloro-3,4-dihydropyrimidin-2-(1 H) one. 4a (1g, 3.2mmol) and 80ml of ammonia at 32% was heated at 250°C under 10 bars for 16h. The solvent was removed in vacuum to afford a solid which was dissolved in water and neutralized with 5M hydrochloric acid. The precipitate obtained was recuperated by filtration and recrystallised from ethanol to give the pure product 6a in 70% yield, mp 236°C, ir ν(C=O) amide 1641, ν(NH) 3415. 1H NMR (DMSO-d6) 2.6 ppm (3H, s, CH3), 3.1 ppm (3H, s, N-CH3), 5.6 ppm (1H, d, J = 3.2 Hz, CH), 7.2-7.6 ppm (4H, m, aromH), 7.9 ppm (1H, s, NH), 12 ppm (1H, s, NH). Anal. Calcd for C13H13N3O2: C, 64.19; H, 5.39; N, 17.27. Found: C, 64.25; H, 5.34; N, 17.21.

3-Ethyl-4-methyl-1,2,3,5,6,10b-hexahydropyrimido[5,4-c]quinoline-2,5-dione (5b).
Compound 5b was prepared with the same procedure as 5a in 73% yield, mp 244°C, ir ν(C=O) amide 1679, 1622, ν(NH) 2990. 1H NMR (DMSO-d6) 1.1 ppm (3H, t, J = 6.9 Hz, CH3 ethyl), 2.6 ppm (3H, s, CH3), 3.6 ppm (1H, m, N-CH ethyl), 3.8 ppm (1H, m, N-CH ethyl), 5.7 ppm (1H, d, J = 3.3 Hz, CH), 7.2-7.5 ppm (4H, m, aromH), 7.8 ppm (1H, s, NH), 12 ppm (1H, s, NH). Anal. Calcd for C14H15N3O2: C, 65.35; H, 5.88; N, 16.33. Found: C, 65.31; H, 5.91; N, 16.35.

3-Ethyl-10-fluoro-4-methyl-1,2,3,5,6,10b-hexahydropyrimido[5,4-c]quinoline-2,5-dione (5c).
Compound 5c was prepared with the same procedure as 5a in 80% yield, mp 228°C, ir ν(C=O) amide 1683, 1630, ν(NH) 3100. 1H NMR (DMSO-d6) 1.1 ppm (3H, t, J = 7.3 Hz, CH3 ethyl), 2.5 ppm (3H, s, CH3), 3.7 ppm (1H, m, N-CH ethyl), 3.8 ppm (1H, m, N-CH ethyl), 5.9 ppm (1H, d, J = 3.6 Hz, CH), 7.3-
7.5 ppm (3H, m, aromH), 7.6 ppm (1H, s, NH), 11.9 ppm (1H, s, NH). Anal. Calcd for C_{14}H_{14}N_{3}O_{2}F: C, 61.08; H, 5.13; F, 6.90; N, 15.26. Found: C, 61.12; H, 5.06; F, 6.94; N, 15.18.

3,4-Dimethyl-9-nitro-1,2,3,5,6,10b-hexahydropyrimido[5,4-c]quinoline-2,5-dione (5d).
Compound 5d was prepared with the same procedure as 5a in 85 % yield, mp 253°C, \( \nu (\text{C}=\text{O}) \) amide 1675, 1620, \( \nu (\text{NH}) \) 2995. \(^1\)H NMR (DMSO-\( d_6 \) ), 2.5 ppm (3H, s, CH\(_3\)), 3.5 ppm (3H, s, N-CH\(_3\)), 5.6 ppm (1H, d, \( J = 3.6 \) Hz, CH), 7.1-7.5 ppm (3H, m, aromH), 7.7 ppm (1H, s, NH), 12.1 ppm (1H, s, NH). Anal. Calcd for C\(_{13}\)H\(_{12}\)N\(_4\)O\(_4\): C, 54.17; H, 4.20; N, 19.44. Found: C, 54.28; H, 4.17; N, 19.37.

7-Chloro-3-ethyl-4-methyl-1,2,3,5,6,10b-hexahydropyrimido[5,4-c]quinoline-2,5-dione (5e).
Compound 5e was prepared with the same procedure as 5a in 73 % yield, mp 250°C, \( \nu (\text{C}=\text{O}) \) amide 1671, 1618, \( \nu (\text{NH}) \) 2998. \(^1\)H NMR (DMSO-\( d_6 \) ) 1.0 ppm (3H, t, \( J = 6.9 \) Hz, CH\(_3\) ethyl), 2.5 ppm (3H, s, CH\(_3\)), 3.7 ppm (1H, m, N-CH ethyl), 3.8 ppm (1H, m, N-CH ethyl), 5.6 ppm (1H, d, \( J = 3.3 \) Hz, CH), 7.2-7.4 ppm (3H, m, aromH), 7.6 ppm (1H, s, NH), 11.9 ppm (1H, s, NH). Anal. Calcd for C\(_{14}\)H\(_{14}\)N\(_4\)O\(_2\)Cl: C, 57.64; H, 4.84; Cl, 12.15; N, 14.40. Found: C, 57.42; H, 4.88; Cl, 12.10; N, 14.51.

10-Chloro-3,4-dimethyl-1,2,3,5,6,10b-hexahydropyrimido[5,4-c]quinoline-2,5-dione (5f).
Compound 5f was prepared with the same procedure as 5a in 90 % yield, mp 258°C, \( \nu (\text{C}=\text{O}) \) amide 1666, 1619, \( \nu (\text{NH}) \) 3005. \(^1\)H NMR (DMSO-\( d_6 \) ) 2.5 ppm (3H, s, CH\(_3\)), 3.2 ppm (3H, s, N-CH\(_3\)), 6.1 ppm (1H, d, \( J = 3.2 \) Hz, CH), 7.2-7.5 ppm (3H, m, aromH), 7.6 ppm (1H, s, NH), 11.6 ppm (1H, s, NH). Anal. Calcd for C\(_{13}\)H\(_{12}\)N\(_3\)O\(_2\)Cl: C, 56.22; H, 4.36; Cl, 12.77; N, 15.13. Found: C, 56.25; H, 4.30; Cl, 12.65; N, 15.22.

7-Chloro-3,4-dimethyl-1,2,3,5,6,10b-hexahydropyrimido[5,4-c]quinoline-2,5-dione (5g).
Compound 5g was prepared with the same procedure as 5a in 81 % yield, mp 254°C, \( \nu (\text{C}=\text{O}) \) amide 1673, 1622, \( \nu (\text{NH}) \) 2990. \(^1\)H NMR (DMSO-\( d_6 \) ) 2.6 ppm (3H, s, CH\(_3\)), 3.2 ppm (3H, s, N-CH\(_3\)), 5.6 ppm (1H, d, \( J = 3.5 \) Hz, CH), 7.2-7.6 ppm (3H, m, aromH), 7.8 ppm (1H, s, NH), 11.9 ppm (1H, s, NH). Anal. Calcd for C\(_{13}\)H\(_{12}\)N\(_3\)O\(_2\)Cl: C, 56.22; H, 4.36; Cl, 12.77; N, 15.13. Found: C, 56.16; H, 4.39; Cl, 12.70; N, 15.24.

REFERENCES