Supporting Information

for

A one-pot electrochemical synthesis of 2-aminothiazoles from active methylene ketones and thioureas mediated by NH$_4$I

Shang-Feng Yang, Pei Li, Zi-Lin Fang, Sen Liang, Hong-Yu Tian, Bao-Guo Sun, Kun Xu and Cheng-Chu Zeng


Experimental procedures, characterization data and copies of spectra of the all synthesized compounds (\textsuperscript{1}H NMR, \textsuperscript{13}C NMR and HRMS)
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1. General information
Starting materials and solvents were obtained from commercial sources and used without further purification. Chromatographic purification of products was accomplished by flash chromatography on silica gel (petroleum ether/EtOAc). The product spots on the thin layer chromatography (TLC) were identified/visualized by fluorescence quenching or by potassium permanganate. NMR spectra were recorded with a 300 MHz spectrometer (300 MHz $^1$H frequency, 75 MHz $^{13}$C frequency). Chemical shifts were referenced to residual undeuterated solvent peaks (note: DMSO-$d_6$: 2.50 ppm $^1$H NMR, 40 ppm $^{13}$C NMR). Coupling constants are reported in Hz. High resolution mass spectra (HRMS) were obtained on a SolariX mass spectrometer.

2. General procedure for the one-pot electrochemically synthesis of 2-aminothiazoles from active methylene ketones and thioureas

A 50 mL undivided cell was equipped with a graphite plate cathode and a graphite plate anode (each about 2 × 2 cm$^2$) which were connected to a DC regulated power supply. To the cell was added active methylene ketone 1 (2 mmol), thiourea 2 (1 mmol), NH$_4$I (0.1 mmol), dL-alanine (1 mmol) and LiClO$_4$ (0.5 mmol) dissolved in a mixed solvent of DMSO (1 mL) and H$_2$O (14 mL). The mixture was electrolyzed under constant current conditions at 5 mA/cm$^2$ at 30 °C while stirring. The electrolysis was terminated when 6 F/mol of charge had been consumed. After the electrolysis, the reaction mixture was washed with a saturated aqueous Na$_2$S$_2$O$_3$ and the product was then extracted with DCM (3 × 10 mL), dried over MgSO$_4$, and concentrated in vacuum. The residue was purified by column chromatography on silica gel using a mixture of petroleum ether/EtOAc as eluent.
### 3. Compounds characterization

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Yield</th>
<th>Color</th>
<th>M.P.  (°C)</th>
<th>Spectroscopic Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl 2-amino-4-methylthiazole-5-carboxylate (3a)</td>
<td>140 mg, 75%</td>
<td>White solid</td>
<td>173-174</td>
<td>¹H NMR (300 MHz, DMSO-d₆) δ (ppm): 1.22 (t, J = 7.2 Hz, 3H), 2.37 (s, 3H), 4.14 (q, J = 7.2 Hz, 2H), 7.72 (br, 2H); ¹³C NMR (75 MHz, DMSO-d₆) δ (ppm): 14.8, 17.6, 60.2, 107.9, 159.8, 162.5, 170.7.</td>
</tr>
<tr>
<td>Methyl 2-amino-4-methylthiazole-5-carboxylate (3b)</td>
<td>138 mg, 80%</td>
<td>Light yellow solid</td>
<td>218-220</td>
<td>¹H NMR (300 MHz, DMSO-d₆) δ (ppm): 2.37 (s, 3H), 3.67 (s, 3H), 7.74 (br, 2H); ¹³C NMR (75 MHz, DMSO-d₆) δ (ppm): 17.6, 51.7, 107.3, 160.1, 162.8, 170.8.</td>
</tr>
<tr>
<td>Tert-butyl 2-amino-4-methylthiazole-5-carboxylate (3c)</td>
<td>109 mg, 51%</td>
<td>Yellow solid</td>
<td>162-163</td>
<td>¹H NMR (300 MHz, DMSO-d₆) δ (ppm): 1.45 (s, 9H), 2.33 (s, 3H), 7.62 (br, 2H); ¹³C NMR (75 MHz, DMSO-d₆) δ (ppm): 17.6, 28.5, 80.6, 109.7, 158.8, 162.0, 170.3.</td>
</tr>
<tr>
<td>Pentyl 2-amino-4-methylthiazole-5-carboxylate (3d)</td>
<td>52 mg, 30%</td>
<td>Yellow waxy solid</td>
<td></td>
<td>¹H NMR (300 MHz, DMSO-d₆) δ (ppm): 0.87 (t, J = 6.6 Hz, 3H), 1.23-1.32 (m, 4H), 1.54-1.64 (m, 2H), 2.37 (s, 3H), 4.09 (t, J = 6.6 Hz, 2H), 7.74 (br, 2H); ¹³C NMR (75 MHz, DMSO-d₆) δ (ppm): 14.4, 17.7, 22.3, 28.3, 28.5, 64.3, 107.9, 159.8, 162.5, 170.8.</td>
</tr>
<tr>
<td>Allyl 2-amino-4-methylthiazole-5-carboxylate (3e)</td>
<td>155 mg, 78%</td>
<td>White solid</td>
<td>151-154</td>
<td>¹H NMR (300 MHz, DMSO-d₆) δ (ppm): 2.38 (s, 3H), 4.63-4.64 (m, 2H), 5.2-5.33 (m, 2H), 5.91-6.01 (m, 1H), 7.79 (br, 2H); ¹³C NMR (75 MHz, DMSO-d₆) δ (ppm): 17.7, 64.6, 107.3, 159.8, 162.5, 170.8.</td>
</tr>
</tbody>
</table>
### Ethyl 2-Amino-4-Methylthiazole-5-Carboxylate (3f)

Yield: 130 mg, 52%; light yellow solid; M.P.: 135-138 °C.

<table>
<thead>
<tr>
<th>Chemical Structure</th>
<th>NMR Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>{H NMR (300 MHz, DMSO-d&lt;sub&gt;6&lt;/sub&gt;) δ (ppm): 2.38 (s, 3H), 5.19 (s, 2H), 7.31-7.39 (m, 5H), 7.78 (br, 2H); 13C NMR (75 MHz, DMSO-d&lt;sub&gt;6&lt;/sub&gt;) δ (ppm): 17.7, 65.6, 107.3, 128.2, 128.4, 129.0, 137.0, 160.5, 162.2, 171.0; HRMS (ESI) calcd for C&lt;sub&gt;12&lt;/sub&gt;H&lt;sub&gt;13&lt;/sub&gt;N&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;2&lt;/sub&gt;S (M+H)&lt;sup&gt;+&lt;/sup&gt; 249.06914, found 249.06923.</td>
<td></td>
</tr>
</tbody>
</table>

### Ethyl 2-Amino-4-Ethylthiazole-5-Carboxylate (3g)

Yield: 127 mg, 65%; yellow solid; M.P.: 174-178 °C.

<table>
<thead>
<tr>
<th>Chemical Structure</th>
<th>NMR Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>{H NMR (300 MHz, DMSO-d&lt;sub&gt;6&lt;/sub&gt;) δ (ppm): 1.11 (t, J = 7.5 Hz, 3H), 1.21 (q, J = 6.3 Hz, 2H), 4.13 (q, J = 7.2 Hz, 2H), 7.75 (br, 2H); 13C NMR (75 MHz, DMSO-d&lt;sub&gt;6&lt;/sub&gt;) δ (ppm): 13.9, 14.9, 24.2, 60.3, 107.2, 162.3, 165.5, 171.1; HRMS (ESI) calcd for C&lt;sub&gt;8&lt;/sub&gt;H&lt;sub&gt;11&lt;/sub&gt;N&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;2&lt;/sub&gt;S (M+H)&lt;sup&gt;+&lt;/sup&gt; 201.06921, found 201.06923.</td>
<td></td>
</tr>
</tbody>
</table>

### Ethyl 2-Amino-4-Propylthiazole-5-Carboxylate (3h)

Yield: 130 mg, 61%; yellow solid; M.P.: 134-135 °C.

<table>
<thead>
<tr>
<th>Chemical Structure</th>
<th>NMR Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>{H NMR (300 MHz, DMSO-d&lt;sub&gt;6&lt;/sub&gt;) δ (ppm): 0.87 (t, J = 6.6 Hz, 3H), 1.22 (t, J = 6.9 Hz, 3H), 1.52-1.62 (m, 2H), 2.80 (t, J = 7.5 Hz, 2H), 4.13 (q, J = 7.2 Hz, 2H), 7.73 (br, 2H); 13C NMR (75 MHz, DMSO-d&lt;sub&gt;6&lt;/sub&gt;) δ (ppm): 14.3, 14.8, 22.4, 32.6, 60.3, 108.0, 162.3, 164.1, 170.9.</td>
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</tr>
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</table>

### Ethyl 2-Amino-4-Isopropylthiazole-5-Carboxylate (3i)

Yield: 114 mg, 58%; yellow solid; M.P.: 171-173 °C.

<table>
<thead>
<tr>
<th>Chemical Structure</th>
<th>NMR Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>{H NMR (300 MHz, DMSO-d&lt;sub&gt;6&lt;/sub&gt;) δ (ppm): 1.20 (d, J = 6.6 Hz, 6H), 1.213 (t, J = 6.9 Hz, 3H), 3.745-3.900 (m, 1H), 4.136 (q, J = 6.9 Hz, 2H), 7.776 (br s, 2H); 13C NMR (75 MHz, DMSO-d&lt;sub&gt;6&lt;/sub&gt;) δ (ppm): 14.8, 22.4, 28.7, 30.2, 31.2, 60.2, 107.8, 162.2, 164.3, 170.9; HRMS (ESI) calcd for C&lt;sub&gt;8&lt;/sub&gt;H&lt;sub&gt;13&lt;/sub&gt;N&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;2&lt;/sub&gt;S (M+H)&lt;sup&gt;+&lt;/sup&gt; 229.10046, found 229.10053.</td>
<td></td>
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### Ethyl 2-Amino-4-Butylthiazole-5-Carboxylate (3j)

Yield: 95 mg, 41%; yellow solid; M.P.: 118-119 °C.

<table>
<thead>
<tr>
<th>Chemical Structure</th>
<th>NMR Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>{H NMR (300 MHz, DMSO-d&lt;sub&gt;6&lt;/sub&gt;) δ (ppm): 0.87 (t, J = 6.6 Hz, 3H), 1.22 (t, J = 7.2 Hz, 3H), 1.24-1.34 (m, 2H), 1.49-1.59 (m, 2H), 2.82 (t, J = 7.2 Hz, 2H), 4.13 (q, J = 7.2 Hz, 2H), 7.73 (br, 2H); 13C NMR (75 MHz, DMSO-d&lt;sub&gt;6&lt;/sub&gt;) δ (ppm): 14.3, 14.8, 22.4, 30.2, 31.2, 60.2, 107.8, 162.2, 164.3, 170.9; HRMS (ESI) calcd for C&lt;sub&gt;10&lt;/sub&gt;H&lt;sub&gt;13&lt;/sub&gt;N&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;2&lt;/sub&gt;S (M+H)&lt;sup&gt;+&lt;/sup&gt; 299.10053, found 299.10053.</td>
<td></td>
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</tbody>
</table>

### Ethyl 2-Amino-4-(TERT-Butyl)Thiazole-5-Carboxylate (3k)

Yield: 51 mg, 24%; yellow waxy solid.

<table>
<thead>
<tr>
<th>Chemical Structure</th>
<th>NMR Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>{H NMR (300 MHz, DMSO-d&lt;sub&gt;6&lt;/sub&gt;) δ (ppm): 1.21 (t, J = 6.9 Hz, 3H), 1.34 (s, 9H), 4.12 (q, J = 6.9 Hz, 2H), 7.67 (br, 2H); 13C NMR (75 MHz, DMSO-d&lt;sub&gt;6&lt;/sub&gt;) δ (ppm): 14.8, 29.6, 36.4, 60.4, 107.0, 161.6, 169.4, 170.7; HRMS (ESI) calcd for C&lt;sub&gt;16&lt;/sub&gt;H&lt;sub&gt;17&lt;/sub&gt;N&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;2&lt;/sub&gt;S (M+H)&lt;sup&gt;+&lt;/sup&gt; 299.10036, found 299.10053.</td>
<td></td>
</tr>
</tbody>
</table>

### Ethyl 2-Amino-4-Cyclohexylthiazole-5-Carboxylate (3l)

Yield: 84 mg, 33%; yellow solid; M.P.: 179-182 °C.
ethyl 2-amino-4-phenylthiazole-5-carboxylate (3m)[3]

Yield: 130 mg, 52%; yellow solid; M.P.: 147-149 °C.

ethyl 2-amino-4-(p-tolyl) thiazole-5-carboxylate (3n)

Yield: 107 mg, 41%; yellow solid; M.P.: 178-181 °C.

ethyl 2-amino-4-(4-methoxyphenyl) thiazole-5-carboxylate (3o)

Yield: 51 mg, 18%; yellow solid; M.P.: 241-244 °C.

ethyl 2-amino-4-(3-methoxyphenyl) thiazole-5-carboxylate (3p)

Yield: 147 mg, 53%; yellow solid; M.P.: 286-304 °C.

ethyl 2-amino-4-(2-methoxyphenyl) thiazole-5-carboxylate (3q)

Yield: 50 mg, 17%; yellow waxy solid.

ethyl 2-amino-4-(4-fluorophenyl) thiazole-5-carboxylate (3r)

Yield: 79 mg, 30%; yellow solid; M.P.: 187-190 °C
<table>
<thead>
<tr>
<th>Compound</th>
<th>Yield</th>
<th>M.P.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl 2-amino-4-(4-chlorophenyl)thiazole-5-carboxylate (3s)</td>
<td>115 mg, 53%; yellow waxy solid.</td>
<td>122.5, 130.8, 132.2, 134.2, 157.8, 161.5, 170.5.</td>
<td>$\delta$ (ppm): 7.3, 7.55, 117.0, 127.0, 127.9, 131.42 and 131.46 (d, J = 5 Hz), 131.6, 132.0, 133.8, 133.8, 157.8, 161.6, 170.5.</td>
</tr>
<tr>
<td>Ethyl 2-amino-4-(4-bromophenyl)thiazole-5-carboxylate (3t)</td>
<td>155 mg, 53%; yellow waxy solid.</td>
<td>122.5, 130.8, 132.2, 134.2, 157.8, 161.5, 170.5.</td>
<td>$\delta$ (ppm): 7.3, 7.55, 117.0, 127.0, 127.9, 131.42 and 131.46 (d, J = 5 Hz), 131.6, 132.0, 133.8, 133.8, 157.8, 161.6, 170.5.</td>
</tr>
<tr>
<td>Ethyl 2-amino-4-(4-nitrophenyl)thiazole-5-carboxylate (3u)</td>
<td>55 mg, 23%; yellow waxy solid.</td>
<td>50, 60.9, 113.0, 121.3, 131.5, 141.4, 147.7, 156.4, 161.4, 170.7.</td>
<td>$\delta$ (ppm): 7.3, 7.55, 117.0, 127.0, 127.9, 131.42 and 131.46 (d, J = 5 Hz), 131.6, 132.0, 133.8, 133.8, 157.8, 161.6, 170.5.</td>
</tr>
<tr>
<td>Ethyl 2-amino-4-(furan-2-yl)thiazole-5-carboxylate (3v)</td>
<td>55 mg, 23%; yellow waxy solid.</td>
<td>122.5, 130.8, 132.2, 134.2, 157.8, 161.5, 170.2.</td>
<td>$\delta$ (ppm): 7.3, 7.55, 117.0, 127.0, 127.9, 131.42 and 131.46 (d, J = 5 Hz), 131.6, 132.0, 133.8, 133.8, 157.8, 161.6, 170.5.</td>
</tr>
<tr>
<td>2-amino-N,N-diethyl-4-methylthiazole-5-carboxamide (3w)</td>
<td>51 mg, 24%; yellow waxy solid.</td>
<td>121.2, 112.4, 144.0, 147.8, 148.5, 161.3, 170.2.</td>
<td>$\delta$ (ppm): 7.3, 7.55, 117.0, 127.0, 127.9, 131.42 and 131.46 (d, J = 5 Hz), 131.6, 132.0, 133.8, 133.8, 157.8, 161.6, 170.5.</td>
</tr>
<tr>
<td>2-amino-4-phenylthiazole-5-carboxamide (3x)</td>
<td>55 mg, 23%; yellow waxy solid.</td>
<td>111.4, 149.5, 163.7, 167.8.</td>
<td>$\delta$ (ppm): 7.3, 7.55, 117.0, 127.0, 127.9, 131.42 and 131.46 (d, J = 5 Hz), 131.6, 132.0, 133.8, 133.8, 157.8, 161.6, 170.5.</td>
</tr>
<tr>
<td>4-phenyl-5-(phenylsulfonyl)thiazol-2-amine (3y)</td>
<td>67 mg, 22%; white solid.</td>
<td>129.3, 130.5, 133.0, 161.5, 171.1.</td>
<td>$\delta$ (ppm): 7.3, 7.55, 117.0, 127.0, 128.6, 130.2, 130.4, 133.7, 134.2, 143.0, 158.3, 171.6.</td>
</tr>
<tr>
<td>Compound</td>
<td>Structure</td>
<td>Yield</td>
<td>M.P.</td>
</tr>
<tr>
<td>----------</td>
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</tr>
<tr>
<td>(2-amino-4-phenylthiazol-5-yl) (phenyl)methanone (3z) [6]</td>
<td><img src="image" alt="Structure" /></td>
<td>Yield: 12 mg, 4%; light yellow solid; M.P.: 157-161 °C.</td>
<td></td>
</tr>
<tr>
<td>1-(2-amino-4-methylthiazol-5-yl)ethan-1-one (3aa) [3]</td>
<td><img src="image" alt="Structure" /></td>
<td>Yield: 39 mg, 25%; light yellow waxy solid.</td>
<td></td>
</tr>
<tr>
<td>Ethyl 4-methyl-2-(methylamino)thiazole-5-carboxylate (3bb) [1]</td>
<td><img src="image" alt="Structure" /></td>
<td>Yield: 154 mg, 77%; light yellow solid; M.P.: 149-151 °C.</td>
<td></td>
</tr>
<tr>
<td>ethyl 4-methyl-2-(phenethylamino)thiazole-5-carboxylate (3cc)</td>
<td><img src="image" alt="Structure" /></td>
<td>Yield: 128 mg, 44%; yellow solid; M.P.: 100-102 °C.</td>
<td></td>
</tr>
</tbody>
</table>

### 4. References


5. Spectra of prepared compounds

$^1$H NMR of ethyl 2-amino-4-methylthiazole-5-carboxylate (3a)

$^{13}$C NMR of ethyl 2-amino-4-methylthiazole-5-carboxylate (3a)
$^1$H NMR of methyl 2-amino-4-methylthiazole-5-carboxylate (3b)

$^{13}$C NMR of methyl 2-amino-4-methylthiazole-5-carboxylate (3b)
$^1$H NMR of tert-butyl 2-amino-4-methylthiazole-5-carboxylate (3c)

$^{13}$C NMR of tert-butyl 2-amino-4-methylthiazole-5-carboxylate (3c)
$^1$H NMR of pentyl 2-amino-4-methylthiazole-5-carboxylate (3d)

$^{13}$C NMR of pentyl 2-amino-4-methylthiazole-5-carboxylate (3d)
$^1$H NMR of allyl 2-amino-4-methylthiazole-5-carboxylate (3e)

$^{13}$C NMR of allyl 2-amino-4-methylthiazole-5-carboxylate (3e)
$^1$H NMR of benzyl 2-amino-4-methylthiazole-5-carboxylate (3f)

$^{13}$C NMR of benzyl 2-amino-4-methylthiazole-5-carboxylate (3f)
HRMS of benzyl 2-amino-4-methylthiazole-5-carboxylate (3f)

\[ \text{HRMS of benzyl 2-amino-4-methylthiazole-5-carboxylate (3f)} \]

\[ \text{\textbf{Peking University Mass Spectrometry Sample Analysis Report}} \]

\[ \text{Analysis Info} \]
- Analysis Name: FTMS-22005052_Fns_2020511_100001.d
- Sample Comment: 0902-61
- Acquisition Date: 5/11/2022 2:43:57 PM
- Operator: Peking University

\[ \text{\textbf{1H NMR of ethyl 2-amino-4-ethylthiazole-5-carboxylate (3g)}} \]

\[ \text{\textbf{1H NMR of ethyl 2-amino-4-ethylthiazole-5-carboxylate (3g)}} \]
$^{13}$C NMR of ethyl 2-amino-4-ethylthiazole-5-carboxylate (3g)

HRMS of ethyl 2-amino-4-ethylthiazole-5-carboxylate (3g)
$^1$H NMR of ethyl 2-amino-4-propylthiazole-5-carboxylate (3h)

$^{13}$C NMR of ethyl 2-amino-4-propylthiazole-5-carboxylate (3h)
$^1$H NMR of ethyl 2-amino-4-isopropylthiazole-5-carboxylate (3i)

$^{13}$C NMR of ethyl 2-amino-4-isopropylthiazole-5-carboxylate (3i)
$^1$H NMR of ethyl 2-amino-4-butylthiazole-5-carboxylate (3j)

$^{13}$C NMR of ethyl 2-amino-4-butylthiazole-5-carboxylate (3j)
HRMS of ethyl 2-amino-4-butylthiazole-5-carboxylate (3j)

1H NMR of ethyl 2-amino-4-(tert-butyl) thiazole-5-carboxylate (3k)
$^{13}$C NMR of ethyl 2-amino-4-(tert-butyl) thiazole-5-carboxylate (3k)

HRMS of ethyl 2-amino-4-(tert-butyl) thiazole-5-carboxylate (3k)
$^1$H NMR of ethyl 2-amino-4-cyclohexylthiazole-5-carboxylate (3l)

$^{13}$C NMR of ethyl 2-amino-4-cyclohexylthiazole-5-carboxylate (3l)
HRMS of ethyl 2-amino-4-cyclohexylthiazole-5-carboxylate (3l)

\[\text{Peaking University Mass Spectrometry Sample Analysis Report}\]

\[\text{Analysis Info}\]

- **Analysis Name**: FTMS-22000052_P02_2200011_000005.d
- **Sample**: 0906-06
- **Comment**: 0906-06

- **Acquisition Date**: 5/11/2022 2:54:14 PM
- **Instrument**: Bruker Solaris FTMS
- **Operator**: Peking University

\[\text{HRMS Graph}\]

\[\text{Bruker Compass DataAnalysis 5.0}\]

\[\text{Page 1 of 1}\]

\[\text{1H NMR of ethyl 2-amino-4-phenylthiazole-5-carboxylate (3m)}\]

\[\text{1H NMR Graph}\]
$^{13}$C NMR of ethyl 2-amino-4-phenylthiazole-5-carboxylate (3m)

$^1$H NMR of ethyl 2-amino-4-(p-tolyl) thiazole-5-carboxylate (3n)
$^{13}$C NMR of ethyl 2-amino-4-(p-tolyl) thiazole-5-carboxylate (3n)

HRMS of ethyl 2-amino-4-(p-tolyl) thiazole-5-carboxylate (3n)
$^1$H NMR of ethyl 2-amino-4-(4-methoxyphenyl) thiazole-5-carboxylate (3o)

$^{13}$C NMR of ethyl 2-amino-4-(4-methoxyphenyl) thiazole-5-carboxylate (3o)
HRMS of ethyl 2-amino-4-(4-methoxyphenyl) thiazole-5-carboxylate (3o)

\[ \text{HRMS of ethyl 2-amino-4-(4-methoxyphenyl) thiazole-5-carboxylate (3o)} \]

\[ \text{HRMS of ethyl 2-amino-4-(4-methoxyphenyl) thiazole-5-carboxylate (3o)} \]

\[ \text{1H NMR of ethyl 2-amino-4-(3-methoxyphenyl) thiazole-5-carboxylate (3p)} \]

\[ \text{1H NMR of ethyl 2-amino-4-(3-methoxyphenyl) thiazole-5-carboxylate (3p)} \]
$^{13}$C NMR of ethyl 2-amino-4-(3-methoxyphenyl) thiazole-5-carboxylate (3p)

HRMS of ethyl 2-amino-4-(3-methoxyphenyl) thiazole-5-carboxylate (3p)
$^1$H NMR of ethyl 2-amino-4-(2-methoxyphenyl) thiazole-5-carboxylate (3q)

$^{13}$C NMR of ethyl 2-amino-4-(2-methoxyphenyl) thiazole-5-carboxylate (3q)
HRMS of ethyl 2-amino-4-(2-methoxyphenyl) thiazole-5-carboxylate (3q)

$^1$H NMR of ethyl 2-amino-4-(4-fluorophenyl) thiazole-5-carboxylate (3r)
$^{13}$C NMR of ethyl 2-amino-4-(4-fluorophenyl) thiazole-5-carboxylate (3r)

HRMS of ethyl 2-amino-4-(4-fluorophenyl) thiazole-5-carboxylate (3r)
$^1$H NMR of ethyl 2-amino-4-(4-chlorophenyl) thiazole-5-carboxylate (3s)

$^{13}$C NMR of ethyl 2-amino-4-(4-chlorophenyl) thiazole-5-carboxylate (3s)
$^1$H NMR of ethyl 2-amino-4-(4-bromophenyl) thiazole-5-carboxylate (3t)

$^{13}$C NMR of ethyl 2-amino-4-(4-bromophenyl) thiazole-5-carboxylate (3t)
$^1$H NMR of ethyl 2-amino-4-(4-nitrophenyl) thiazole-5-carboxylate (3u)

$^{13}$C NMR of ethyl 2-amino-4-(4-nitrophenyl) thiazole-5-carboxylate (3u)
$^1$H NMR of ethyl 2-amino-4-(furan-2-yl) thiazole-5-carboxylate (3v)

$^{13}$C NMR of ethyl 2-amino-4-(furan-2-yl) thiazole-5-carboxylate (3v)
$^1$H NMR of 2-amino-N, N-diethyl-4-methylthiazole-5-carboxamide (3w)

$^{13}$C NMR of 2-amino-N, N-diethyl-4-methylthiazole-5-carboxamide (3w)
$^1$H NMR of 2-amino-4-phenylthiazole-5-carbonitrile (3x)

$^{13}$C NMR of 2-amino-4-phenylthiazole-5-carbonitrile (3x)
$^1$H NMR of 4-phenyl-5-(phenylsulfonyl) thiazol-2-amine (3y)

$^{13}$C NMR of 4-phenyl-5-(phenylsulfonyl) thiazol-2-amine (3y)
HRMS of 4-phenyl-5-(phenylsulfonyl) thiazol-2-amine (3y)

1H NMR of (2-amino-4-phenylthiazol-5-yl) (phenyl)methanone (3z)
$^{13}$C NMR of (2-amino-4-phenylthiazol-5-yl) (phenyl)methanone (3z)

$^1$H NMR of 1-(2-amino-4-methylthiazol-5-yl)ethan-1-one (3aa)
$^{13}$C NMR of 1-(2-amino-4-methylthiazol-5-yl)ethan-1-one (3aa)

$^1$H NMR of ethyl 4-methyl-2-(methylamino) thiazole-5-carboxylate (3bb)
$^{13}$C NMR of ethyl 4-methyl-2-(methylamino) thiazole-5-carboxylate (3bb)

$^1$H NMR of ethyl 4-methyl-2-(phenethylamino) thiazole-5-carboxylate (3cc)
$^{13}$C NMR of ethyl 4-methyl-2-(phenethylamino) thiazole-5-carboxylate (3cc)

![NMR spectrum]

HRMS of ethyl 4-methyl-2-(phenethylamino) thiazole-5-carboxylate (3cc)

![HRMS spectrum]