Synthesis of 3,8-Diaryl-2,5,6,7-tetrahydro-1,4,7-thiadiazonone and 3,9-Diaryl-5,6,7,8-tetrahydro-2H-1,4,8-thia diazecines

S. S. Sandhu, S. S. Tandon, Harjit Singh
Department of Chemistry, Guru Nanak Dev University, Amritsar 143005, India

The ring systems of 1,4,7-thiadiazonine and 1,4,8-thiazadiazecine have hitherto not been described. Our interest in these ring systems is derived from the unusual ligating properties regarding metal ions\(^1\)-\(^4\) and metal carboxyls\(^5\)-\(^8\) of medium-size heterocycles containing two or more hetero atoms. We describe here a convenient synthesis of the title compounds.

The condensation of diphenacyl sulfide\(^9\) (1, R = H) with 1,2-diaminoethane in various solvents in the absence or presence of an acid under usual conditions or under high-dilution conditions leads to the formation of complex product mixtures. However, when the same condensation is performed in ethylene glycol/ethanol\(^9\) (3 + 2) at room temperature, T.L.C. monitoring reveals that the reaction proceeds at a moderately slow reaction rate and 3,8-diaryl-2,5,6,7-tetrahydro-1,4,7-thiadiazonine (2, R = H) is formed as the major product. Similarly, compounds 2 (R = CH\(_3\), Cl, OCH\(_3\)) may be obtained in moderate yields.

The mass spectra of compounds 2 (M\(^+\) = 294, 322, 363, and 354, respectively) were in agreement with the assigned structure. However, the \(^1\)H-N.M.R. spectra of the products could as well be interpreted by three other structures, 3a, 3b, and 4.

![Chemical Structures](image)

The structure of the condensation products was then ascertained to be 2 on the basis of the \(^13\)C-N.M.R. spectra. The three signals at \(\delta = 32.3, 33.2, 62.4\), and 52.399 ppm could be assigned to the three sp\(^3\) hybridised methylene carbons in structure 2 because in the off-resonance proton-decoupled spectrum these singlets split into triplets (\(J = 22\) Hz). The absence of any other signal in the upfield region and thereby the absence of any additional sp\(^2\) carbon rules out the bicyclic structure 4 which possesses an additional sp\(^3\) carbon at the bridgehead. These observations further rule out the existence of 3a and 3b. Among the signals appearing at lower field, the singlet at \(\delta = 94.670\) ppm split into a doublet (\(J = 26\) Hz) in the off-resonance proton-decoupled spectrum; it could be the signal of the sp\(^3\) carbon (C-2). Three of the downfield signals \(\delta = 139.3, 141.081, 143.370\) ppm which do not split in the off-resonance proton-decoupled spectrum could be assigned to C-3, C-8, and the C-atoms of the phenyl groups linked to C-3 and C-8. The remaining downfield signals \(\delta = 125.299, 126.372, 127.430, 128.138\) ppm which split into doublets (\(J = 6\) Hz) in the off-resonance proton-decoupled spectrum might be assigned to the remaining C-atoms of the phenyl groups.

Table. 1,4,7-Thiadiazonine (2) and 1,4,8-Thiadiazecine (5) Derivatives

<table>
<thead>
<tr>
<th>Product</th>
<th>R</th>
<th>m.p.</th>
<th>Yield(^a) [(%)]</th>
<th>Molecular formula(^b)</th>
<th>L.R. (CHCl(<em>3)) (\nu</em>{max} [\text{cm}^{-1}])</th>
<th>(^1)H-N.M.R. (CDCl(_3)) (\delta [\text{ppm}])</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>H</td>
<td>123-124(^o)</td>
<td>30</td>
<td>C(<em>{16})H(</em>{14})N(_2)S (294.4)</td>
<td>3350, 3070 (N-H); 1595 (C-N)</td>
<td>7.45-7.00 (m, 10H(\text{aryl})); 5.20 (broadened s, 1H, (\equiv\text{CH-})); 3.60-2.50 (m, 6H, CH(_3)); 2.32 (t, 1H, (\equiv\text{NH}))</td>
</tr>
<tr>
<td>2</td>
<td>CH(_3)</td>
<td>semi-solid</td>
<td>25</td>
<td>C(<em>{20})H(</em>{22})N(_2)S (322.3)</td>
<td>3350 (N-H); 1605 (C-N)</td>
<td>7.56-7.00 (m, 8H(\text{aryl})); 5.12 (broadened s, 1H, (\equiv\text{CH-})); 4.10-2.50 (m, 6H, CH(_3)); 2.30 (t, 3H, CH(_3)); 2.35 (t, 3H, CH(_3)); 2.08 (broadened s, 1H, NH)</td>
</tr>
<tr>
<td>2</td>
<td>Cl</td>
<td>144-145(^o)</td>
<td>25</td>
<td>C(<em>{16})H(</em>{14})Cl(_2)N(_2)S (363.2)</td>
<td>3360 (N-H); 1585 (C-N)</td>
<td>7.50-7.10 (m, 8H(\text{aryl})); 5.25 (broadened s, 1H, (\equiv\text{CH-})); 3.72-2.60 (m, 6H, CH(_3)); 2.35 (t, 1H, NH)</td>
</tr>
<tr>
<td>2</td>
<td>OCH(_3)</td>
<td>97-98(^o)</td>
<td>25</td>
<td>C(<em>{20})H(</em>{22})N(_2)O(_2)S (354.3)</td>
<td>3290 (N-H); 1608 (C-N)</td>
<td>7.50-6.75 (m, 8H(\text{aryl})); 5.20 (broadened s, 1H, (\equiv\text{CH-})); 3.70-2.60 (m, 6H, CH(_3)); 3.72 (t, 3H, OCH(_3)); 3.77 (s, 3H, OCH(_3)); 2.40 (t, 3H, NH)</td>
</tr>
<tr>
<td>5</td>
<td>H</td>
<td>144-145(^o)</td>
<td>50</td>
<td>C(<em>{16})H(</em>{14})O(_2)S (308.5)</td>
<td>—</td>
<td>7.81-7.17 (m, 10H(\text{aryl})); 5.12 (t, 1H, (\equiv\text{CH-})); 3.12-2.50 (m, 8H, CH(_3)); 2.37 (t, 1H, NH)</td>
</tr>
<tr>
<td>5</td>
<td>CH(_3)</td>
<td>124-125(^o)</td>
<td>40</td>
<td>C(<em>{20})H(</em>{22})O(_2)S (336.3)</td>
<td>—</td>
<td>7.65-7.15 (m, 8H(\text{aryl})); 5.07 (s, 1H, (\equiv\text{CH-})); 3.05-2.05 (m, 8H, CH(_3)); 2.33 (s, 3H, CH(_3)); 2.37 (s, 3H, CH(_3)); 2.07 (broadened s, 1H, NH)</td>
</tr>
</tbody>
</table>

\(^a\) Recrystallized from ethyl acetate.
\(^b\) All compounds gave satisfactory microanalyses: C, ± 0.33; H, ± 0.17; N, ± 0.21; S, ± 0.24.
\(^c\) Exchanged slowly with D\(_2\)O in ~48 h.
\(^d\) Exchanged with D\(_2\)O instantaneously.

© 1979 Georg Thieme Publishers
The analogous cyclocondensation of diphenacyl sulfoxides (1, R = H, CH₃) with 1,3-diaminopropane affords 3,9-diaryl-5,6,7,8-tetrahydro-2H-1,4,8-thiadiazecines (5).

![Chemical Structure](attachment:image.png)

In the cyclocondensations reported here, the ethylene glycol used as co-solvent probably plays an essential role by bringing the carbonyl groups of 1 closer together by hydrogen bonding and thus rendering possible the condensation of both carbonyl groups with one molecule of the diamine. Cyclic diamines of the types 2 and 5 having other hetero atoms in place of S have hitherto not been prepared by the method described here.

Melting points were determined by the capillary method and are uncorrected. The ¹H-N.M.R. and ¹³C-N.M.R. spectra were recorded on Tesla BS 487 (80 MHz) and Varian XL-100 instruments, respectively. The mass spectra were recorded on a Hitachi-Perkin-Elmer RMU-6D mass spectrometer and the I.R. spectra on a C.Z. specord-71 instrument. T.L.C. analyses were carried out on silica gel G plates using chloroform as eluent and an iodine chamber for development.

3,8-Diaryl-2,5,6,7-tetrahydro-1,4,7-thiadiazonines (2): General Procedure:

1,2-Diaminoethane (0.9 g, 0.015 mol) is added with stirring to a warm solution of the diphenacyl sulfide 1 (0.01 mol) in ethylene glycol/ethanol (3:2: 100 ml). The reaction proceeds slowly and is complete within 8–12 days (as shown by T.L.C. monitoring). The mixture is extracted with ether (4 x 150 ml). The extract is washed with water (4 x 150 ml) and dried with sodium sulfate. The solvent is removed in vacuo and the residue is chromatographed over a column with alumina (neutral) using petroleum ether (40–60°)/ethyl acetate (70:30) as eluent.

3,9-Diaryl-5,6,7,8-tetrahydro-2H-1,4,8-thiadiazecines (5):

These compounds are prepared by the above procedure, using 1,3-diaminopropane (11.1 g, 0.015 mol) in place of 1,2-diaminoethane.

We thank the UGC, New Delhi, for financial assistance and Prof. P. J. Scheuer, Honolulu, for help in recording the ¹³C-N.M.R. spectra.

Received: June 1, 1978
(Revised form: July 12, 1978)

---

6. This solvent system has previously been used to advantage in the synthesis of 3,6-disubstituted 2,7-dihydro-1,4,5-thiadiazepines: S. S. Sandhu, S. S. Tandon, H. Singh, Indian J. Chem. [B] 15, 664 (1977).