CHAPTER III

SPECTRAL ANALYSIS
CHAPTER III A

UV SPECTRA
(1) U.V.Spectra of 7-hydroxy coumarin (IIa)

![Graph 1](image1)

- **SYSTRONICS**
- **U.V.VIS SPECTROPHOTOMETER-119**
- **Base Graph**: GI-1
- **Mode of Operation**: Scan mode
- **No. Peak**: 1
  - $\lambda_{max} = 482.30$ nm
  - 1.4587 Abs.
  - U.V.SPECTRA NO.1

(2) U.V.Spectra of 7-acetoxy coumarin (IIa₁)

![Graph 2](image2)

- **SYSTRONICS**
- **U.V. VIS SPECTROPHOTOMETER - 119**
- **Base Graph**: GI-2
- **Mode of Operation**: Scan mode
- **No. Peak**: 1
  - $\lambda_{max} = 418.3$ nm
  - 3.1384 Abs.
  - U.V.SPECTRA NO.2
(3) U.V.Spectra of 7-hydroxy-8-aceto coumarin (II\textsubscript{2})

![Graph 1](image1)

SYSTRONIC
UV VIS SPECTROPHOTOMETER - 119
Base Graph GI-3
Mode of Operation Scan mode
No. Peak
1 \( \lambda_{\text{max}} = 330.1 \) nm 2.3717 Abs
U.V.Spectra No - 3

(4) U.V.Spectra of 7-hydroxy-8-aceto coumarin hydrazone (II\textsubscript{3})

![Graph 2](image2)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER - 119
Base Graph GI-4
Mode of Operation Scan mode
No. Peak
1 \( \lambda_{\text{max}} = 393.5 \) nm 2.7169 Abs
U.V. SPECTRA NO.4
(5) U.V.Spectra of 7-hydroxy-8-aceto-N-(4',6'-dichloro-1',3',5'-s-triazino) coumarin hydrazone. (IIb)

![Graph of U.V.Spectra for (5)](image)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER-119
Base Graph GJ-5
Mode of Operation Scan Mode
No.Peak

1 \( \lambda_{\text{max}} = 338.3 \text{ nm} \) 1.9632 Abs

U.V. SPECTRA NO-5

(6) U.V.Spectra of 7-hydroxy-8-aceto-N-[4'-(2''-nitro,4''-methoxy, amino-phenyl)-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIb)

![Graph of U.V.Spectra for (6)](image)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER-119
Base Graph GJ-6
Mode of Operation Scan mode
No. Peak

1 \( \lambda_{\text{max}} = 392.3 \text{ nm} \) 1.4678 Abs

U.V.SPECTRA NO.6
(7) U.V.Spectra of 7-hydroxy-8-aceto-N-[4'-(2'',5''-dimethoxy,4''-chloro-amino phenyl-),6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIb₂)

(8) U.V.Spectra of 7-hydroxy-8-aceto-N-[4'-(2'',2'''-dichloro,4'',4'''-di amino di phenyl)-,6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIb₃)
(9) U.V. Spectra of 7-hydroxy-8-aceto-N-[4'-{(2''-methyl-4''-chloro-amino phenyl)-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIb₄)

![Graph of U.V. Spectra of 7-hydroxy-8-aceto-N-[4'-{(2''-methyl-4''-chloro-amino phenyl)-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone.](image)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER-119
Base Graph GJ-9
Mode of Operation Scan mode
No. Peak
1. \( \lambda_{\text{max}} = 562.28 \text{ nm} \) 2.1044 Abs
U.V. SPECTRA NO.9

(10) U.V. Spectra of 7-hydroxy-8-aceto-N-[4'-{(2''-hydroxy-5''-nitro amino phenyl)-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIb₅)

![Graph of U.V. Spectra of 7-hydroxy-8-aceto-N-[4'-{(2''-hydroxy-5''-nitro amino phenyl)-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone.](image)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER-119
Base Graph GJ-10
Mode of Operation Scan mode
No. Peak
1. \( \lambda_{\text{max}} = 340.4 \text{ nm} \) 0.9264 Abs
U.V. SPECTRA NO.10
(11) U.V. Spectra of 7-hydroxy-8-aceto-N-[4'- (2''-methoxy-4''-nitro amino phenyl)- 6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIb₆)

![Graph of U.V. Spectra](image1)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER-119
Base Graph   GI-11
Mode of Operation  Scan mode
No.   Peak
1. $\lambda_{\text{max}} = 403.68$ nm  1.9321 Abs
U.V. SPECTRA NO.11

(12) U.V. Spectra of 7-hydroxy-8-aceto-N-[4'- (2''-methoxy-5''-chloro amino phenyl)- 6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIb₇)

![Graph of U.V. Spectra](image2)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER-119
Base Graph   GI-12
Mode of Operation  Scan mode
No.   Peak
1. $\lambda_{\text{max}} = 445.41$ nm  1.4527 Abs
U.V. SPECTRA NO.12
(13) U.V. Spectra of 7-hydroxy-8-aceto - N-[4’-(2”-methoxy-5”-nitro amino phenyl)- 6’-chloro-1’3’,5’-s-triazino] coumarin hydrazone. (IIb8)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER-119
Base Graph       GJ-13
Mode of Operation Scan mode
No.              Peak
1. \( \lambda_{max} = 423.9 \text{ nm} \) 1.2994 Abs
U.V.SPECTRA NO.13

(14) U.V. Spectra of 7-hydroxy-8-aceto - N-[4’-(2”-methyl-5”-nitro amino phenyl)- 6’-chloro-1’3’,5’-s-triazino] coumarin hydrazone. (IIb9)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER-119
Base Graph       GJ-14
Mode of Operation Scan mode
No.              Peak
1. \( \lambda_{max} = 301.3 \text{nm} \) 1.3906 Abs
U.V.SPECTRA NO.14

![Graph of U.V. Spectra of 7-hydroxy-8-aceto – N-[4’-(3”-amino, 2”",2”"-dimethyl-azobenzene-Yl)-6’-chloro-1’,3’,5’-s-triazino] coumarin hydrazone. (IIb₁₀)](image)

**SYSTRONICS**
**UV. VIS SPECTROPHOTOMETER-119**
Base Graph  G1-15
Mode of Operation  Scan mode
NO.  Peak
1. λ<sub>max</sub> = 543.7 nm  2.1902 Abs
U.V.SPECTRA NO-15

(16) U.V. Spectra of (16) 7-hydroxy-8-aceto – N-[4’-(1”",4”"-diamino phenyl) 6’-chloro-1’,3’,5’-s-triazino] coumarin hydrazone (IIb₁₁)

![Graph of U.V. Spectra of (16) 7-hydroxy-8-aceto – N-[4’-(1”",4”"-diamino phenyl) 6’-chloro-1’,3’,5’-s-triazino] coumarin hydrazone (IIb₁₁)](image)

**SYSTRONICS**
**UV. VIS SPECTROPHOTOMETER-119**
Base Graph  G1-16
Mode of Operation  Scan mode
NO.  Peak
1. λ<sub>max</sub> = 379.8 nm  1.7995 Abs
U.V.SPECTRA NO-16
(17) U.V. Spectra of 7-hydroxy-8-aceto - N-[4’-(4’’-nitro amino phenyl) - 6’-chloro-1’,3’,5’-s-triazino] coumarin hydrazone. (IIb₁₂)

![Graph of U.V. Spectra](image1)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER-119
Base Graph GJ-17
Mode of Operation Scan mode
No. Peak
1. \( \lambda_{\text{max}} = 452.1 \text{ nm} \ 2.1465 \text{ Abs} 
U.V. SPECTRA NO.17

(18) U.V. Spectra of 7-hydroxy-8-aceto - N-[4’-(2’’-nitro-4’’-chloro-amino phenyl) - 6’-chloro-1’,3’,5’-s-triazino] coumarin hydrazone. (IIb₁₃)

![Graph of U.V. Spectra](image2)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER-119
Base Graph GJ-18
Mode of Operation Scan mode
No. Peak
1. \( \lambda_{\text{max}} = 644.7 \text{ nm} \ 2.1021 \text{ Abs} 
U.V. SPECTRA NO.18
(19) U.V. Spectra of 7-hydroxy-8-aceto - N-[4'- (4''-amino-3'''-hydroxy-4'''-carboxy azo-benzene-yl)- 6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIb14)

(20) U.V. Spectra of 7-hydroxy-8-aceto - N-[4'- (4''-amino-4'''-sulpho-azo-benzene-yl)- 6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIb15)
(21) U.V. Spectra of 7-hydroxy-8-aceto- N-[4'- (4'',4'''-di amino-diphenyl-amido)- 6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIB16)

(22) U.V. Spectra of 7-hydroxy-8-aceto – N-[4’-(4'',4'''-di amino-diphenyl-sulphamido)- 6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIB17)
(23) U.V. Spectra of 7-hydroxy-8-aceto - N-[4'-(4''-4'''-di amino-diphenyl)-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIb₁₈)

(24) U.V. Spectra of 7-hydroxy-8-aceto - N-[4''-amino-(5'''-methyl-pyrazole-yl) phenyl sulphamido]-6'-chloro-1',3',5'-s-triazino}coumarin hydrazone. (IIb₁₉)
(25) U.V. Spectra of 7-hydroxy-8-aceto – N-\{4'-ureido-6'-chloro-1',3',5'-s-triazino\} coumarin hydrazone. (IIb_{20})

(26) U.V. Spectra of Bis[7-hydroxy-8-aceto-N-(4-6-dichloro-1',3',5'-s-triazino) coumarin hydrazone] copper(II). (IIc_{1})
(27) U.V. Spectra of Bis[7-hydroxy-8-aceto-N-(4-6-dichloro-1',3',5'-S-triazino) coumarin hydrazone] Nickel(II). (IIc₁)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER- 119
Base Graph GRU-02
Mode of Operation Scan mode
No. Peak
1. λ<sub>max</sub> = 404 nm 1.6125 Abs
U.V. SPECTRA NO. 27

(28) U.V. Spectra of Bis[7-hydroxy-8-aceto-N-(4-6-dichloro-1',3',5'-S-triazino) coumarin hydrazone] Cobalt(II). (IIc₃)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER- 119
Base Graph GRU-03
Mode of Operation Scan Mode
No. Peak
1. λ<sub>max</sub> = 450 nm 2.3590 Abs
U.V. SPECTRA NO. 28
(29) U.V. Spectra of Ferrous(II)[7-hydroxy-8-aceto-N-(4-6-dichloro-1',3',5'-S-triazino) coumarin hydrazone]. (IIc₄)

(30) U.V. Spectra of Ferric (III)[7-hydroxy-8-aceto-N-(4-6-dichloro-1',3',5'-S-triazino) coumarin hydrazone]. (IIc₅)
(31) U.V. Spectra of Bis[7 hydroxy-8-aceto coumarin hydrazone] copper(II). (IId₁)

(32) U.V. Spectra of Bis[7 hydroxy-8-aceto coumarin hydrazone] Nickel(II). (IId₂)
(33) U.V. Spectra of Bis[7 hydroxy-8-aceto coumarin hydrazone] Cobalt (II). (IId₃)

![Graph](image1)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER-119
Base Graph GR-08
Mode of Operation Scan Mode
No. Peak
1. λ_{max} = 340.3 nm, λ_{5831} Abs
U.V. SPECTRA NO. 33

(34) U.V. Spectra of Ferrous(II)[7 hydroxy-8-aceto coumarin hydrazone]. (IId₄)

![Graph](image2)

SYSTRONICS
UV. VIS SPECTROPHOTOMETER-119
Base Graph GR-09
Mode of Operation Scan mode
No. Peak
1. λ_{max} = 225.6 nm, λ_{5251} Abs
U.V. SPECTRA NO. 34
(35) U.V. Spectra of Ferric (III)[7 hydroxy-8-aceto coumarin hydrazone]. (IIId₃)

![UV Spectra Graph]

**SYSTRONICS**
UV. VIS SPECTROPHOTOMETER-119
Base Graph GRI-10
Mode of Operation Scan mode
No. Peak
1. \( \lambda_{max} = 282.1 \text{ nm} \) 2.4612 Abs

U.V.SPECTRA NO. 35
CHAPTER—III B

I.R. SPECTRA
1. I.R. Spectra of 7-hydroxy-coumarin(IIa)

2. I.R. Spectra of 7-acetoxy coumarin(IIa₁)
3. I.R. Spectra of 7-hydroxy-8-aceto coumarin(IIa₂)

4. I.R. Spectra of 7-hydroxy-8-aceto coumarin hydrazone(IIa₃)
5. I.R. Spectra of 7-hydroxy-8-aceto-N-(4',6'-dichloro-1',3',5'-s-triazino) coumarin hydrazone. (IIb)


![Diagram of 7-hydroxy-8-aceto- N-[4’-(2”-methyl-4”-chloro-amino phenyl)-6’-chloro-1’,3’,5’-s-triazino] coumarin hydrazone.]


![Diagram of 7-hydroxy-8-aceto – N-[4’-(2”-hydroxy-5”-nitro amino phenyl)-6’-chloro-1’,3’,5’-s-triazino] coumarin hydrazone.]

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12. I.R. Spectra of 7-hydroxy-8-aceto- N-[4'- (2''-methoxy-5''-chloro amino phenyl)- 6''-chloro-1',3',5'-s-triazino] coumarin hydrzone. (IIb7)

15. I.R. Spectra of $7$-hydroxy-$8$-aceto $N$-[4'-(3''-amino, 2'',2''-dimethyl-azobenzene-yl)-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone.(IIb$_{10}$)

16. I.R. Spectra of $7$-hydroxy-$8$-aceto $N$-[4'-(1'',4''-diamino phenyl)-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone(IIb$_{11}$)
17. I.R. Spectra of 7-hydroxy-8-aceto- N-[4'-(4''-nitro amino phenyl) - 6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIb_{12})

18. I.R. Spectra of 7-hydroxy-8-aceto- N-[4'-(2''-nitro-4''-chloro- amino phenyl) - 6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIb_{13})


24. I.R. Spectra of 7-hydroxy-8-aceto - N-[4''-amino-(5''''-methyl-pyrazole-yl) phenyl sulphamido]-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. (IIb₁₉)
25. I.R. Spectra of 7-hydroxy-8-aceto – N -[4’-ureido-6’-chloro-
1’,3’,5’-s-triazino] coumarin hydrazone.(IIb20)
<table>
<thead>
<tr>
<th>No.</th>
<th>Compound</th>
<th>O-H cm⁻¹</th>
<th>N-H cm⁻¹ stretching</th>
<th>=C-H cm⁻¹</th>
<th>C-H cm⁻¹</th>
<th>C=O cm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>1.</td>
<td>7-hydroxy-coumarin (IIa)</td>
<td>3440-3445</td>
<td>-</td>
<td>3045</td>
<td>2940-2990</td>
<td>1710</td>
</tr>
<tr>
<td>2.</td>
<td>7-acetoxy coumarin (IIa₁)</td>
<td>-</td>
<td>-</td>
<td>3050</td>
<td>2950</td>
<td>1700</td>
</tr>
<tr>
<td>3.</td>
<td>7-hydroxy-8-aceto coumarin (IIa₂)</td>
<td>3450</td>
<td>-</td>
<td>3050</td>
<td>2950-2980</td>
<td>1690-1708</td>
</tr>
<tr>
<td>4.</td>
<td>7-hydroxy-8-aceto coumarin hydrazone (IIa₃)</td>
<td>3440</td>
<td>3300-3350 (dublet)</td>
<td>3040</td>
<td>2930</td>
<td>1690</td>
</tr>
<tr>
<td>5.</td>
<td>7-hydroxy-8-aceto-N-(4',6'-dichloro-1',3',5'-s-triazino) coumarin hydrazone. (IIb)</td>
<td>3400-3445</td>
<td>3350-3360</td>
<td>3040</td>
<td>2950</td>
<td>1740</td>
</tr>
<tr>
<td>6.</td>
<td>7-hydroxy-8-aceto-N-{4'-(2'-nitro,4'-methoxy,amino-phenyl)-6'-chloro-1',3',5'-s-triazino} coumarin hydrazone. (IIb₁)</td>
<td>3450-3550</td>
<td>3350</td>
<td>3080</td>
<td>2960-3000</td>
<td>1720</td>
</tr>
<tr>
<td>7.</td>
<td>7-hydroxy-8-aceto-N-{4'-(2',5'-dimethoxy,4'-chloro-amino-phenyl)-6'-chloro-1',3',5'-s-triazino} coumarin hydrazone. (IIb)</td>
<td>3380-3440</td>
<td>3280</td>
<td>3050</td>
<td>2950-3000</td>
<td>1730</td>
</tr>
<tr>
<td>8.</td>
<td>7-hydroxy-8-aceto-N-{4'-(2',2'-dichloro,4',4'-di amino di phenyl)-6'-chloro-1',3',5'-s-triazino} coumarin hydrazone. (IIb)</td>
<td>3450-3550</td>
<td>3280-3325</td>
<td>3080</td>
<td>2975</td>
<td>1720-1800</td>
</tr>
<tr>
<td>9.</td>
<td>7-hydroxy-8-aceto-N-{4'-(2'-methyl-4'-chloro-amino phenyl)-6'-chloro-1',3',5'-s-triazino} coumarin hydrazone. (IIb₄)</td>
<td>3400-3440</td>
<td>3280 (s)</td>
<td>3050</td>
<td>2960-2990</td>
<td>1700</td>
</tr>
</tbody>
</table>

Peak around 3000 – 2900 cm⁻¹ and 1500 cm⁻¹ and around 810 and 660 (bending) are ATR peaks (chapter-II ref-7)

Table continue .............
<table>
<thead>
<tr>
<th>No.</th>
<th>Compound</th>
<th>O-H cm⁻¹</th>
<th>N-H cm⁻¹ stretching</th>
<th>=C-H cm⁻¹</th>
<th>-C-H cm⁻¹</th>
<th>C=O cm⁻¹</th>
<th>C= cm</th>
<th>C=C cm⁻¹</th>
<th>CH₃ cm⁻¹ bending</th>
<th>-C-O-C- cm⁻¹ stretching</th>
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<tbody>
<tr>
<td>10</td>
<td>7-hydroxy-8-aceto – N-[4'-(2'-hydroxy-5'-nitro amino phenyl)-6'-chloro-1',3',5'-s-triazine] coumarin hydrazone. (llb₅)</td>
<td>3530</td>
<td>3280</td>
<td>3080</td>
<td>2900-2960</td>
<td>1720</td>
<td>16₆</td>
<td>1540-1580</td>
<td>1375</td>
<td>1200-1140</td>
</tr>
<tr>
<td>11</td>
<td>7-hydroxy-8-aceto – N-[4'-(2'-methoxy-4'-nitro amino phenyl)-6'-chloro-1',3',5'-s-triazine] coumarin hydrazone. (llb₆) (d)</td>
<td>3430</td>
<td>3300-3350</td>
<td>3080</td>
<td>2910-2960</td>
<td>1690</td>
<td>16₄</td>
<td>1600-1620</td>
<td>1375-1420</td>
<td>1080-1250</td>
</tr>
<tr>
<td>12</td>
<td>7-hydroxy-8-aceto – N-[4'-(2'-methoxy-5'-chloro amino phenyl)-6'-chloro-1',3',5'-s-triazine] coumarin hydrazone. (llb₇)</td>
<td>3420-3440</td>
<td>3280-3350</td>
<td>3070</td>
<td>2950-2990</td>
<td>1710</td>
<td>16₆</td>
<td>1580-1620</td>
<td>1375-1410</td>
<td>1070-1280</td>
</tr>
<tr>
<td>13</td>
<td>7-hydroxy-8-aceto – N-[4'-(2'-methoxy-5'-nitro amino phenyl)-6'-chloro-1',3',5'-s-triazine] coumarin hydrazone. (llb₈)</td>
<td>3420-3460</td>
<td>3350</td>
<td>3010-3040</td>
<td>2920-2970</td>
<td>1720</td>
<td>16₂</td>
<td>1580</td>
<td>1380-1150</td>
<td>1050-1150</td>
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<td>14</td>
<td>7-hydroxy-8-aceto – N-[4'-(2'-methyl-5'-nitro amino phenyl)-6'-chloro-1',3',5'-s-triazine] coumarin hydrazone. (llb₉)</td>
<td>3400-3440</td>
<td>3300-3350</td>
<td>3040</td>
<td>2930</td>
<td>16₈</td>
<td>16₆</td>
<td>1600</td>
<td>1375-1250</td>
<td>1070-1250</td>
</tr>
<tr>
<td>15</td>
<td>7-hydroxy-8-aceto – N-[4'-(3'-amino, 2',2''-dimethyl-azobenzene-YI)-6'-chloro-1',3',5'-s-triazine] coumarin hydrazone. (llb₁₀)</td>
<td>3480</td>
<td>3320-3400</td>
<td>3070</td>
<td>2950-2990</td>
<td>1700</td>
<td>16₆</td>
<td>1580-1620</td>
<td>1375-1060</td>
<td>1080-1080</td>
</tr>
<tr>
<td>16</td>
<td>7-hydroxy-8-aceto – N-[4'-(1',4''-diamino phenyl) 6'-chloro-1',3',5'-s-triazine] coumarin hydrazone (llb₁₁)</td>
<td>3420-3480</td>
<td>3320-3340</td>
<td>3050</td>
<td>2950</td>
<td>1700</td>
<td>16₆</td>
<td>1580</td>
<td>1380-1150</td>
<td>1150-1240</td>
</tr>
<tr>
<td>17</td>
<td>7-hydroxy-8-aceto – N-[4'-(4'-nitro amino phenyl) 6'-chloro-1',3',5'-s-triazine] coumarin hydrazone. (llb₁₂)</td>
<td>3420-3520</td>
<td>3300-3340</td>
<td>3000-3080</td>
<td>2920-2950</td>
<td>1700</td>
<td>16₆</td>
<td>1580</td>
<td>1360-1160</td>
<td>1100-1160</td>
</tr>
<tr>
<td>18</td>
<td>7-hydroxy-8-aceto – N-[4'-(2'-nitro-4'-chloro amino phenyl) 6'-chloro-1',3',5'-s-triazine] coumarin hydrazone. (llb₁₃)</td>
<td>3420-3480</td>
<td>3310-3340</td>
<td>3060</td>
<td>2950</td>
<td>1700</td>
<td>16₆</td>
<td>1580</td>
<td>1380-1140</td>
<td>1140-1250</td>
</tr>
</tbody>
</table>

Table continue .................
<table>
<thead>
<tr>
<th>NO</th>
<th>Compound</th>
<th>O-H cm(^{-1})</th>
<th>N-H cm(^{-1}) stretching</th>
<th>(=\text{C-H}) cm(^{-1})</th>
<th>(-\text{C-H}) cm(^{-1})</th>
<th>C=O cm(^{-1})</th>
<th>C=C cm(^{-1})</th>
<th>CH(^3) cm(^{-1}) bending</th>
<th>-C-O-C- cm(^{-1}) stretching</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.</td>
<td>7-hydroxy-8-aceto-(N) [4'-(4'')-amino-3''-hydroxy-4''-carboxy azo-benzene-yl]-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. ([lb]14)</td>
<td>3400-3440</td>
<td>3280-3380</td>
<td>3060</td>
<td>2940</td>
<td>1710</td>
<td>11</td>
<td>1580</td>
<td>1630</td>
</tr>
<tr>
<td>20.</td>
<td>7-hydroxy-8-aceto-(N) [4'-(4'')-amino-4''-sulpho-azo-benzene-yl]-6''-chloro-1',3',5'-s-triazino] coumarin hydrazone. ([lb]15)</td>
<td>3420-3460</td>
<td>3300-3370</td>
<td>3000-3090</td>
<td>2960-2980</td>
<td>1720</td>
<td>11</td>
<td>1580</td>
<td>1600</td>
</tr>
<tr>
<td>21.</td>
<td>7-hydroxy-8-aceto-(N) [4'-(4'',4'''-di amino-diphenyl-amido)]-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. ([lb]16)</td>
<td>3500-3520</td>
<td>3280-3320</td>
<td>3000-3080</td>
<td>2920-2980</td>
<td>1660</td>
<td>11</td>
<td>1580</td>
<td>1370</td>
</tr>
<tr>
<td>22.</td>
<td>7-hydroxy-8-aceto-(N) [4'-(4'',4'''-di amino-diphenyl-sulphamido)]-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. ([lb]17)</td>
<td>3400-3480</td>
<td>3310-3350</td>
<td>3080</td>
<td>2820-2990</td>
<td>1680</td>
<td>11</td>
<td>1580</td>
<td>1390</td>
</tr>
<tr>
<td>23.</td>
<td>7-hydroxy-8-aceto-(N) [4'-(4'',4'''-di amino-diphenyl)]-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. ([lb]18)</td>
<td>3400-3450</td>
<td>3300-3380</td>
<td>3050</td>
<td>2950-2980</td>
<td>1700</td>
<td>11</td>
<td>1590</td>
<td>1380</td>
</tr>
<tr>
<td>24.</td>
<td>7-hydroxy-8-aceto-(N) [4'-(4'')-amino-(5''-methyl-pyrazole-yl) phenyl sulphamido]-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. ([lb]19)</td>
<td>3400-3460</td>
<td>3300-3350</td>
<td>3000-3080</td>
<td>2880-2920</td>
<td>1680</td>
<td>11</td>
<td>1580</td>
<td>1380</td>
</tr>
<tr>
<td>25.</td>
<td>7-hydroxy-8-aceto-(N) [4'-ureido-6'-chloro-1',3',5'-s-triazino] coumarin hydrazone. ([lb]20)</td>
<td>3400-3460</td>
<td>3280-3380</td>
<td>3000-3070</td>
<td>2960</td>
<td>1680</td>
<td>11</td>
<td>1550</td>
<td>1370</td>
</tr>
</tbody>
</table>
The presence of a broad intense band between 3600-3200 cm\(^{-1}\) in spectra of 7-hydroxy-8-aceto coumarin hydrazone and 7-hydroxy-8-aceto-N-(4',6'-dichloro, 1',3',5'-S-triazino) coumarin hydrazone indicates the presence of O-H group showing H-bonding but the absence of this absorption band in the spectrum of all the chelates suggest that it is involved in the chelate formation giving M-O bond with the removal of hydrogen of phenolic O-H group and other linkage is through nitrogen atom of N-NH\(_2\) group giving M-N bond and hence the I.R. absorption data supports the following structure of the chelate.

\[ \text{Structure of the chelate} \]

The observation drawn from the I.R spectra are given in tabular form and supports the above structural details. It gives C=C, C-C, N-H, C=N stretching bands.
I.R. spectra of Bis[7-hydroxy-8-aceto-N-(4',6'-dichloro-1',3',5'-S-triazino) coumarin hydrazone]copper(II)(IICl)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Frequencies</th>
<th>Interference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>No Broad Band Between</td>
<td>This shows that 'H; of O-H group in involved in chelate formation with metal.</td>
</tr>
<tr>
<td></td>
<td>3600-3200 cm⁻¹</td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>3300 cm⁻¹</td>
<td>Sharp band due to N-H stretching mode for 2° amine single band.</td>
</tr>
<tr>
<td>C.</td>
<td>1700 cm⁻¹</td>
<td>Peak for c=O stretching</td>
</tr>
<tr>
<td>D.</td>
<td>1610 cm⁻¹</td>
<td>It is due to C=N stretching mode which is superimposed on N-H bending mode.</td>
</tr>
<tr>
<td></td>
<td>1520 cm⁻¹</td>
<td></td>
</tr>
<tr>
<td>E.</td>
<td>1375 cm⁻¹</td>
<td>It is due to CH₃ banding mode.</td>
</tr>
<tr>
<td>F.</td>
<td>1110 cm⁻¹</td>
<td>These may be due to C-O stretching mode.</td>
</tr>
</tbody>
</table>

Peaks around 3000 – 2900 cm⁻¹ and around 1500 cm⁻¹ and bending around 660 cm⁻¹ 810 cm⁻¹ are aromatic peaks. (Chapter-II ref-7)
I.R. spectra of Bis[7-hydroxy-8-aceto-N-(4',6'-dichloro-1',3',5'-S-triazino) coumarin hydrazone] Nickel(II) (IIc₂)

Symbol | Frequencies | Interference
--- | --- | ---
A. | No Broad Band Between 3600-3200 cm⁻¹ | This shows that 'H; of O-H group in involved in chelate formation with metal.
B. | 3250 cm⁻¹ | Sharp band due to N-H stretching mode no doublet :: 2⁰ amine.
C. | 1700 cm⁻¹ | Due to c=0 stretching
D. | 1370 cm⁻¹ | It is due to CH₃ banding mode.
E. | 1070 cm⁻¹ | These may be due to C-O stretching mode.

Peak around 3000-2900 cm⁻¹ and 1500 cm⁻¹ and bending around 820 cm⁻¹ 680 cm⁻¹ are aromatic peak. (Chapter-II ref-7)
I.R. spectra of Bis[7-hydroxy-8-aceto-N-(4',6'-dichloro-1',3',5'-S-triazino) coumarin hydrazone] Cobalt(II) (\textit{llc}_3)

Symbol | Frequencies | Interference
--- | --- | ---
A. | No Broad Band Between 3600-3200 cm\(^{-1}\) | This shows that 'H; of O-H group in involved in chelate formation with metal.
B. | 3350 cm\(^{-1}\) | Sharp band due to N-H stretching mode.
C. | 1760 cm\(^{-1}\) | It is due to C=N stretching mode which is superimposed on N-H bending mode.
D. | 1700 cm\(^{-1}\) | Peak for \(\text{C-O}\) stretching
E. | 1370 cm\(^{-1}\) | It is due to CH\(_3\) banding mode.
F. | 1000 cm\(^{-1}\) | These may be due to C-O stretching mode.

Peak around 3000 – 2900 cm\(^{-1}\) and also around 1500 cm\(^{-1}\) and c-H bending peak are aromatic peaks (Chapter-II ref-7)
I.R. spectra of Ferrous (II) [7-hydroxy-8-aceto-N-(4',6'-dichloro-1',3',5'-S-triazino) coumarin hydrazone] (Ilc₄)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Frequencies</th>
<th>Interference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>No Broad Band Between 3600-3200 cm⁻¹</td>
<td>This shows that 'H; of O-H group in involved in chelate formation with metal.</td>
</tr>
<tr>
<td>B.</td>
<td>3380 cm⁻¹</td>
<td>Sharp band due to N-H stretching mode.</td>
</tr>
<tr>
<td>C.</td>
<td>1700 cm⁻¹</td>
<td>Peak due to c=o stretching</td>
</tr>
<tr>
<td>D.</td>
<td>1375 cm⁻¹</td>
<td>It is due to CH₃ banding mode.</td>
</tr>
<tr>
<td>E.</td>
<td>1050 cm⁻¹</td>
<td>These may be due to C-O stretching mode.</td>
</tr>
</tbody>
</table>

Peak around 3000-2900 cm⁻¹ and also around 1500 cm⁻¹ and C-H Bending peak 840 cm⁻¹ are aromatic peaks. (Chapter-II ref-7)
I.R. spectra of Ferric(III)[7-hydroxy-8-aceto-N-(4',6'-dichloro-1',3',5'-S-triazino) coumarin hydrazone] (Ilc₃)

Symbols | Frequencies | Interference
--- | --- | ---
A. | No Broad Band Between 3600-3200 cm⁻¹ | This shows that 'H; of O-H group in involved in chelate formation with metal.
B. | 3380 cm⁻¹ | Sharp band due to N-H stretching mode single peak 2° amine.
C. | 1700 cm⁻¹ | Peak due to c=0 stretching
D. | 1375 cm⁻¹ | It is due to CH₃ banding mode.

Peak around 3000-2900 cm⁻¹ and also around 1500 cm⁻¹ and C-H bending peak around 680 and 820 cm⁻¹ are aromatic peaks.
I.R. spectra of Bis[7-hydroxy-8-aceto coumarin hydrazone]copper(II) (IId_i)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Frequencies</th>
<th>Interference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>No Broad Band</td>
<td>This shows that 'H; of O-H group in involved in chelate formation with metal.</td>
</tr>
<tr>
<td></td>
<td>Between 3600-3200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>cm(^{-1})</td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>3350 cm(^{-1})</td>
<td>Sharp band due to N-H stretching mode for (2^b) amine single band.</td>
</tr>
<tr>
<td>C.</td>
<td>1700 cm(^{-1})</td>
<td>Peak for c=O stretching</td>
</tr>
<tr>
<td>D.</td>
<td>1680 cm(^{-1})</td>
<td>It is due to C=N stretching mode which is superimposed on N-H bending mode.</td>
</tr>
<tr>
<td>E.</td>
<td>1375 cm(^{-1})</td>
<td>It is due to (\text{CH}_3) banding mode.</td>
</tr>
<tr>
<td>F.</td>
<td>1120 cm(^{-1})</td>
<td>These may be due to C-O stretching mode.</td>
</tr>
</tbody>
</table>

Peaks around 3000 – 2900 cm\(^{-1}\) and around 1500 cm\(^{-1}\) and bending around 660 cm\(^{-1}\) 810 cm\(^{-1}\) are aromatic peaks. (Chapter-II ref-7)
I.R. spectra of Bis[7-hydroxy-8-aceto coumarin hydrazone]Nickel(II) (II\textsubscript{2})

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Frequencies</th>
<th>Interference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>No Broad Band Between 3600-3200 cm\textsuperscript{-1}</td>
<td>This shows that 'H; of O-H group in involved in chelate formation with metal.</td>
</tr>
<tr>
<td>B.</td>
<td>3350 cm\textsuperscript{-1}</td>
<td>Sharp band due to N-H stretching mode.</td>
</tr>
<tr>
<td>C.</td>
<td>1700 cm\textsuperscript{-1}</td>
<td>Due to c=o stretching</td>
</tr>
<tr>
<td>D.</td>
<td>1380 cm\textsuperscript{-1}</td>
<td>It is due to CH\textsubscript{3} banding mode.</td>
</tr>
<tr>
<td>E.</td>
<td>1050 cm\textsuperscript{-1}</td>
<td>These may be due to C-O stretching mode.</td>
</tr>
</tbody>
</table>

Peak around 3000-2900 cm\textsuperscript{-1} and 1500 cm\textsuperscript{-1} and bending around 820 cm\textsuperscript{-1} 680 cm\textsuperscript{-1} are aromatic peak. (Chapter-II ref-7)
I.R. spectra of Bis[7-hydroxy-8-aceto coumarin hydrazone]Cobalt(II) (lld$_3$)

### Symbol Frequencies Interference

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Frequencies</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>No Broad Band Between 3600-3200 cm$^{-1}$</td>
<td>This shows that 'H; of O-H group in involved in chelate formation with metal.</td>
</tr>
<tr>
<td>B.</td>
<td>3350 cm$^{-1}$</td>
<td>Sharp band due to N-H stretching mode.</td>
</tr>
<tr>
<td>C.</td>
<td>1700 cm$^{-1}$</td>
<td>Peak for c=o stretching</td>
</tr>
<tr>
<td>D.</td>
<td>1650 cm$^{-1}$</td>
<td>It is due to C=N stretching mode which is superimposed on N-H bending mode.</td>
</tr>
<tr>
<td>E.</td>
<td>1375 cm$^{-1}$</td>
<td>It is due to CH$_3$ banding mode.</td>
</tr>
<tr>
<td>F.</td>
<td>1285 cm$^{-1}$</td>
<td>These may be due to C-O stretching mode.</td>
</tr>
</tbody>
</table>

Peak around 3000 – 2900 cm$^{-1}$ and also around 1500 cm$^{-1}$ and c-H bending peak are aromatic peaks (Chapter-II ref-7)
I.R. spectra of Ferrous (II) [7-hydroxy-8-aceto coumarin hydrazone](lld₄)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Frequencies</th>
<th>Interference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>No Broad Band Between 3600-3200 cm⁻¹</td>
<td>This shows that 'H; of O-H group in involved in chelate formation with metal.</td>
</tr>
<tr>
<td>B.</td>
<td>3320 cm⁻¹</td>
<td>Sharp band due to N-H stretching mode.</td>
</tr>
<tr>
<td>C.</td>
<td>1700 cm⁻¹</td>
<td>Peak due to c=0 stretching</td>
</tr>
<tr>
<td>D.</td>
<td>1375 cm⁻¹</td>
<td>It is due to CH₃ banding mode.</td>
</tr>
<tr>
<td>E.</td>
<td>1060 cm⁻¹</td>
<td>These may be due to C-O stretching mode.</td>
</tr>
</tbody>
</table>

Peak around 3000-2900 cm⁻¹ and also around 1500 cm⁻¹ and C-H Bending peak 830 cm⁻¹ are aromatic peaks. (Chapter-11 ref-7)
I.R. spectra of Ferric (III) [7-hydroxy-8-aceto coumarin hydrazone](II₃f₃)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Frequencies</th>
<th>Interference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>No Broad Band Between 3600-3200 cm⁻¹</td>
<td>This shows that ‘H; of O-H group in involved in chelate formation with metal.</td>
</tr>
<tr>
<td>B.</td>
<td>3370 cm⁻¹</td>
<td>Sharp band due to N-H stretching mode single peak 2° amine.</td>
</tr>
<tr>
<td>C.</td>
<td>1700 cm⁻¹</td>
<td>Peak due to c=0 stretching</td>
</tr>
<tr>
<td>D.</td>
<td>1375 cm⁻¹</td>
<td>It is due to CH₃ banding mode.</td>
</tr>
</tbody>
</table>

Peak around 3000-2900 cm⁻¹ and also around 1500 cm⁻¹ and C-H bending peak around 680 and 820 cm⁻¹ are aromatic peaks.
CHAPTER—III C

NMR SPECTRA
1H NMR Spectra of 7-hydroxy coumarin

Molecular Formula = C₉H₆O₃

Internal Standard : TMS ; Solvent : CDCl₃ ; Instrument : Bruker DRX-300

A xerox copy of NMR spectra of 7-ethoxy - 4 - methyl coumarin which is taken from the text of Applications of NMR(spectra No 294), is attached on Page No.: 113 for comparison purpose.

The NMR spectra of 7-hydroxy coumarin is gives: One doublet for aromatic H at positions a & b around $\delta$ 7.10 & 7.03 ppm and a second doublet for aromatic H at positions c & d $\delta$ 6.78 & 6.82 ppm and third an overlapping doublet for aromatic H positions at c & e $\delta$ 6.82 & 6.78 ppm. For phenolic-OR the peak is seen at $\delta$ 10.8 ppm.

The peak for -OH group at $\delta$ 10.8 ppm is removed in the NMR spectra 7-acetoxy coumarin.
1H NMR Spectra of 7- acetoxy coumarin

Molecular Formula = C_{11}H_{8}O_{4}

Internal Standard : TMS ; Solvent : CDCl_{3} ; Instrument : DRX : 300

Similarly to 7-hydroxy coumarin (i) gives a doublet for aromatic H at position a & b \( \delta = 7.49 \) and \( \delta = 7.37 \) ppm (ii) a second doublet for aromatic H at position c&d around \( \delta = 7.28 \) & \( \delta = 7.11 \) ppm and (iii) third doublet for aromatic H \( \delta = 7.26 \) and \( \delta = 7.13 \) ppm and other overlapping doublet seen.

The peak for –CH$_3$ group at \( \delta = 2.35 \) ppm and there is no peak for –OH at \( \delta = 10 \) ppm .\ indicating it acetylation.
**1H NMR Spectra of 7-hydroxy-8-aceto coumarin**

![NMR Spectra Image]

**Molecular Formula** = \( \text{C}_{11}\text{H}_{8}\text{O}_4 \)

**GJ-3**

<table>
<thead>
<tr>
<th>Signal No.</th>
<th>Signal position (δ ppm)</th>
<th>Relative No. of protons</th>
<th>Multiplicity</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.091</td>
<td>3H</td>
<td>Singlet</td>
<td>-COCH\textsubscript{3}</td>
</tr>
<tr>
<td>2</td>
<td>6.1827-7.963</td>
<td>The doublets of Aromatic H</td>
<td>Ar-H</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10.575</td>
<td>1H</td>
<td>Singlet</td>
<td>-OH</td>
</tr>
</tbody>
</table>
**1H NMR Spectra of 7-hydroxy-8-aceto coumarin hydrazone**

![NMR Spectra](image)

**Molecular Formula** = $C_{11}H_{10}N_2O_3$

**Internal Standard:** TMS; **Solvent:** CDCl$_3$, **Instrument:** Bruker DRX-300

<table>
<thead>
<tr>
<th>Signal No.</th>
<th>Signal position (δ ppm)</th>
<th>Relative No. of protons</th>
<th>Multiplicity</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.091</td>
<td>3H</td>
<td>Singlet</td>
<td>-CH$_3$</td>
</tr>
<tr>
<td>2</td>
<td>6.180-7.961</td>
<td>Doublets of aromatic H</td>
<td></td>
<td>Ar-H</td>
</tr>
<tr>
<td>3</td>
<td>9.176</td>
<td>1H</td>
<td>Singlet</td>
<td>Ar-NH</td>
</tr>
<tr>
<td>4</td>
<td>10.575</td>
<td>1H</td>
<td>Singlet</td>
<td>Ar-OH</td>
</tr>
</tbody>
</table>
1H NMR Spectra of 7-hydroxy-8-aceto-N-(4',6'-dichloro-1',3',5'-s-triazino) coumarin hydrazone

Molecular Formula = C_{14}H_{9}Cl_{2}N_{5}O_{3}

GJ-5

Internal Standard : TMS; Solvent : CDCl$_3$; Instrument : DRX : 300

<table>
<thead>
<tr>
<th>Signal No.</th>
<th>Signal position (δ ppm)</th>
<th>Relative No. of protons</th>
<th>Multiplicity</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.091</td>
<td>3H</td>
<td>Singlet</td>
<td>-CH$_3$</td>
</tr>
<tr>
<td>2</td>
<td>6.180-7.961</td>
<td>Doubles of aromatic H</td>
<td>Ar-H</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10.5</td>
<td>1H</td>
<td>Singlet</td>
<td>Ar-NH</td>
</tr>
<tr>
<td>4</td>
<td>11.12</td>
<td>1H</td>
<td>Singlet</td>
<td>Ar-OH</td>
</tr>
</tbody>
</table>
1H NMR Spectra of 7-hydroxy-8-aceto-N-[4'-(2''-nitro,4''-methoxy, amino-phenyl)-,6'-Chloro-1'3'5'-s-triazino) coumarin hydrazone]

![Chemical Structure](image)

Molecular Formula = $C_{21}H_{16}ClN_7O_6$

GJ-6

<table>
<thead>
<tr>
<th>Signal No.</th>
<th>Signal position ($\delta$ ppm)</th>
<th>Relative No. of protons</th>
<th>Multiplicity</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.21</td>
<td>3H</td>
<td>Singlet</td>
<td>-CH$_3$</td>
</tr>
<tr>
<td>2</td>
<td>3.92</td>
<td>3H</td>
<td>Singlet</td>
<td>-OCH$_3$</td>
</tr>
<tr>
<td>3</td>
<td>6.180-8.114</td>
<td>Doublets of aromatic H</td>
<td>Ar-H</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8.11</td>
<td>1H</td>
<td>Singlet</td>
<td>Ar-NH-</td>
</tr>
<tr>
<td>5</td>
<td>11.199</td>
<td>1H</td>
<td>Singlet</td>
<td>-OH</td>
</tr>
</tbody>
</table>
1H NMR Spectra of 7-hydroxy-8-aceto-N-[4''-(4''-nitro amino phenyl)-6'-Chloro-1'3'5'-s-triazino] coumarin hydrazone.

Molecular Formula = C₁₀H₁₄ClN₇O₅

GJ-17

<table>
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<tr>
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<th>Signal position (δ ppm)</th>
<th>Relative No. of protons</th>
<th>Multiplicity</th>
<th>Inference</th>
</tr>
</thead>
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1H NMR Spectra of 7-hydroxy-8-aceto-N-[4’-(4”,4”'-diaminodiphenyl)-6’-Chloro-1’3’5’-s-triazino] coumarin hydrazone.

Molecular Formula = C_{26}H_{20}ClN_{7}O_{3}
GJ-23

Internal Standard: TMS; Solvent: CDCl₃; Instrument: DRX: 300

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<th>Signal position (δ ppm)</th>
<th>Relative No. of protons</th>
<th>Multiplicity</th>
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Applications of Nuclear Magnetic Resonance