by merging of the two separate solvation spheres around the two oxygen atoms into a single solvation sphere. The exclusion of the hydrophobic chain and cooperative hydrogen bonding between the water molecules may provide the additional stability. Extensive studies carried out by Yang et al. on water mediated folding of dicarboxylate dianionic systems support the above hypothesis. They showed that when the number of water molecules around the charge bearing oxygen atoms reaches the threshold value, the system folds bringing the oxygen atoms close together and excluding the hydrophobic chain.

As the compound was soluble in water and existence of hemiacetal in water was precluded, it was envisioned that the experimental evidence for the above-mentioned degenerate rearrangement could be provided in terms of deuteration studies. It is well established that the protons alpha to carbonyl carbon atom are acidic enough to enolize in the presence of catalytic amount of acid or base and they can be exchanged with deuterium atoms in the presence of D$_2$O. Thus, in case hydride shuttling occurs between C-1 and C-6, one would expect deuterium labeling at C-2, C-10 as well as C-5 and C-7 as the hydroxyl will be converted to carbonyl at one stage. In the absence of hydride shift the deuterium incorporation would occur only at C-2 and C-10. The position and number of the deuterium atoms could be easily ascertained by the means of NMR and mass spectroscopy.

The keto-alcohol (1), when heated under reflux with K$_2$CO$_3$ in D$_2$O for 48 h (1:2:20 mole ratio) lead to the incorporation of deuterium atoms at C-2, C-5, C-7 and C-10 leading to formation of octadeuterated hydroxyketone 2 (details are discussed later). Treatment of 1 with CF$_3$COOD in 1:2 molar ratio, however, led to the recovery of the starting material only. The acid used in the above reaction was obtained from trifluoroacetic anyhydride and D$_2$O. However, since the boiling point of the compound obtained was lower (64°C) than the expected range (b.p. of CF$_3$COOD: 74-75°C), the authenticity of CF$_3$COOD was doubtful. The experiment was then repeated with the commercially available DCI. Interestingly, 1 when
treated with catalytic amount of DCI in D2O (1:0.05:20 mole ratio) at room temperature provided 2 in 9 days. The progress of the exchange was followed by 1H and 13C NMR. Employing the same acidic conditions, hydroxyketone (1) when irradiated with microwaves at 660 W, lead to the formation of product 2 only in 10 min (Scheme 2.1). The starting material was recovered as such when the deuteration was attempted with the aid of microwaves under basic conditions.

Scheme 2.1. Synthesis of 2,5,7,10-octadeuterated-6-hydroxycyclodecanone (2) under acidic and basic conditions.

The insertion of deuterium atoms at positions alpha to carbonyl as well as hydroxyl group was revealed by 1H NMR and 13C NMR spectroscopy. 1H NMR of 1 in D2O consists of a multiplet at δ 3.84 ppm corresponding to proton attached to C-6 whereas two complex multiplets at δ 2.41 and 2.77 ppm are attributed to the presence of protons alpha to carbonyl moiety. However, 1H NMR of the product 2 showed absence of the protons alpha to carbonyl carbon whereas the proton attached to C-6 appeared as a singlet at δ 3.66 ppm, which indicates the absence of protons alpha to carbon bearing hydroxyl group (Table 2.1).
Table 2.1. $^1$H NMR$^1$, $^{13}$C NMR$^2$, I.R., Mass and HRCI Mass Spectral data of 6-hydroxycyclodecanone (1) and 2,2,5,5,7,7,10,10-d$_8$-6-hydroxycyclodecanone (2).

<table>
<thead>
<tr>
<th>Compd.</th>
<th>$^1$H NMR (300 MHz, in CDCI$_3$)</th>
<th>$^{13}$C NMR (300 MHz, in CDCI$_3$)</th>
<th>I.R. (KBr, cm$^{-1}$)</th>
<th>Mass Spectrum, m/z (relative intensity)</th>
<th>HRCIMS (M$^+$ Na$^+$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.48-1.97 (m, 30H), 2.31-2.40 (m, 2H, alpha to &gt;C=O), 2.60-2.69 (m, 2H, alpha to &gt;C=O), 3.82-3.88 (m, 1H, -CH$_2$OH), 4.05-4.19 (m, 1H, -CH$_2$-COH).</td>
<td>22.68 (C-4 &amp;C-8), 23.16 (C-3 &amp;C-9), 24.11 (C-4' &amp; C-8'), 24.81 (C-3' &amp; C-9'), 33.57 (C-5 &amp; C-7), 33.77(C-5' &amp; C-7'), 40.39 (C-2' &amp; C-10'), 41.75 (C-2 &amp; C-10), 62.00 (C-6), 75.41 (C-6'), 102.58 (C-1').</td>
<td>1009, 1358, 1461, 1690 (&gt;C=O$<em>{wa}$), 2912, 2933, 3386 (&gt;OH$</em>{wa}$), 3429.</td>
<td>170 (M$^+$, 2.3), 153 (34.2), 152 (31.7), 135 (42.1), 134 (22.4), 126 (16.2), 124 (16.3), 123 (17.1), 114 (14.5), 113 (51.9), 111 (14.9), 110 (11.0), 108 (34.4), 101 (15.3), 100 (31.9), 97 (14.8), 96 (22.0), 95 (64.1), 86 (10.5), 85 (100), 84 (40.8), 83 (25.8), 82 (40.9), 81 (32.3), 80 (10.8), 79 (19.1), 73 (35.7), 71 (26.6), 70 (53.8).</td>
<td>193.1205 (calc. 193.12045).</td>
</tr>
<tr>
<td></td>
<td>1.49-1.95 (m, 30H), 3.81 (s, 1H, -CH$_2$OH), 4.05 (s, 1H, -CH$_2$-COH).</td>
<td>22.41 (C-4 &amp;C-8), 22.99 (C-3 &amp;C-9), 23.87 (C-4' &amp; C-8'), 24.59 (C-3' &amp; C-9'), 32.99 (C-5 &amp; C-7), 35 &amp; C-7', weak cluster), 41.12 (C-2' &amp; C-10', C-2 &amp; C-10, weak cluster), 68.97 (C-6), 75.08 (C-6'), 102.58 (C-1').</td>
<td>1022, 1350, 1454, 1700 (&gt;C=O$<em>{wa}$), 2860, 2928, 3394 (&gt;OH$</em>{wa}$).</td>
<td>180 (0.7), 179 (2.2), 178 (4.3), 177 (4.0), 176 (1.6), 175 (0.7), 160 (48.8), 141 (38.5), 129 (14.8), 118 (30.4), 113 (58.0), 105 (19.1), 91 (51.5), 89 (100), 85 (57.0), 82 (17.5), 79 (3.9), 70 (79.4).</td>
<td>201.1700 (calc. 201.17065).</td>
</tr>
</tbody>
</table>

$^1$Chemical shift values are expressed as $\delta$ values (ppm) downfield from tetramethylsilane as internal standard for CDCI$_3$ solutions while in D$_2$O the shifts are expressed as $\delta$ values (ppm) considering resonance of C$_6$H$_5$-OH as reference;

$^2$Chemical shift values are expressed as $\delta$ values (ppm) using deuterated chloroform (CDCl$_3$) as internal standard while in D$_2$O the shifts are given in ppm considering resonance of C-OH as reference.
Further, $^{13}$C NMR of 1 (in D$_2$O) displayed six peaks; the peak at $\delta$ 42.99 ppm corresponds to C-2 and C-10 (alpha to carbonyl) while the peak at $\delta$ 33.68 ppm is assigned to C-5 and C-7, i.e., alpha to the carbon bearing hydroxyl group. $^{13}$C NMR of 2 displayed the weak clusters of peaks at $\delta$ 42.59 and 33.20 ppm indicating the presence of deuterium atoms at all these carbons. The final support for the deuterium insertion at positions alpha to carbonyl and hydroxyl was provided by Mass spectroscopy, which indicated the product with percentage deuterium distribution of $[^2H_5]$ 9.1; $[^2H_6]$ 14.5, $[^2H_7]$ 41.2, $[^2H_8]$ 26.2, $[^2H_9]$ 6.7, $[^2H_{10}]$ 2.1; (average $[^2H_{7,1}]$).

The exchange of deuterium atoms at positions alpha to carbonyl and hydroxyl is in agreement with the well-established mechanism of the hydride shift in the hydroxy ketones. In a base catalyzed pathway, an alkoxide is formed, which enhances the hydridic character of the methine hydrogen. Due to spatial proximity, the carbonyl group is properly juxtaposed to act as a receptor for the hydride from C-6. This hydride migration leads to interchangeability of the hydroxyl and carbonyl moiety leading to the formation of the degenerate system. Due to enolization, the deuterium atoms are exchanged at positions alpha to C-1 as well as C-6 (Scheme 2.2).

**Scheme 2.2.** Base and acid catalyzed reaction of 6-hydroxycyclodecanone (1) in D$_2$O.
In the presence of catalytic amount of acid, it is the carbonyl oxygen, rather than alcohol oxygen, that is protonated though the alcohol oxygen is 4-5 $pK_a$ units more basic than the carbonyl oxygen. The preference for protonation at the 'wrong' oxygen may be attributed to the induction of hydride shift from C-6 to C-1 leading thereby to the formation of degenerate compound.

Under these mild conditions (5 mol % of acid) the side products, such as the ones formed by the rearrangement due to protonation of hydroxyl group, were not observed and the deuterated product was recovered in very high yields.

The possibility of the involvement of homoenolization (as shown below) in these isomerizations can be ruled out, as the $-CH-OH$ proton remains intact and is not exchanged with the deuterium during the reaction.

Though our results are explained by a mechanism that involves the hydride shift from C-6 to C-1, alternative routes, i.e., hydride shifts from other positions must be ruled out. To prove unambiguously that the eight-deuterium insertion is because of hydride shuttling specifically between C-1 and C-6, studies were carried out on model compounds: 6-methyl-6-hydroxycyclodecanone (3) and 6-(1,1,1-triphenylmethoxy)cyclodecanone (4).
In hydroxy-ketone 3, hydrogen at C-6 is replaced by the methyl group. As the migration of methyl is energetically disfavored, inter-conversion of carbonyl and hydroxyl could not occur. In other case, the hydroxyl at C-6 is protected as ether in 4. This shall restrict an important step in the proposed mechanism, i.e., the oxidation of hydroxyl to keto group (under acidic conditions) and formation of alkoxide leading to the hydride shift (under basic conditions). As the hydride shift in this case is not feasible, exchange of protons with deuterium atoms at positions alpha to carbonyl moiety was the expected phenomenon.

6-methyl-6-hydroxycyclodecanone (3) when refluxed with K$_2$CO$_3$ in D$_2$O (1:2:20 mole ratio) lead to the formation of tetradeterated product 5 (Scheme 2.3).

![Scheme 2.3. Synthesis of 2,2,10,10-d$_4$-6-methyl-6-hydroxycyclodecanone (5) and 2,2,10,10-d$_4$-6-(1,1,1-triphenylmethoxy)cyclodecanone (6) under basic conditions.](image)

The $^1$H NMR of 3 exhibits a complex multiplet at $\delta$ 2.59 ppm corresponding to protons alpha to carbonyl moiety whereas in the product the intensity of this multiplet diminished indicating the replacement of these protons by the deuterium atoms. In $^{13}$C NMR, the peak corresponding to the C-2 and C-10 (at $\delta$ 42.58 ppm in D$_2$O) turned out to be a weak cluster, while other peaks remained intact as in starting material (Table 2.2). Finally, the LRCIMS
Chapter 2 showed the \((\text{M+Na}^+)\) peak at 211 for 5 inferring the presence of four deuterium atoms.

Table 2.2. \(^1\)H NMR, \(^{13}\)C NMR, I.R. and Mass Spectral data of 6-methyl-6-hydroxycyclodecanone (3) and 2,2,10,10-d4-6-methyl-6-hydroxycyclodecanone (5).

<table>
<thead>
<tr>
<th>Compound</th>
<th>Spectrum</th>
<th>(^1)H NMR (300 MHz, In CDC(\text{Cl}_3))</th>
<th>(^{13})C NMR (300 MHz, In CDC(\text{Cl}_3))</th>
<th>(^1)H NMR (300 MHz, In D(\text{2}O))</th>
<th>(^{13})C NMR (300 MHz, In D(\text{2}O))</th>
<th>I.R. (KBr, cm(^{-1}))</th>
<th>Mass Spectrum (m/z)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td><img src="image" alt="Diagram of Compound 3" /></td>
<td>1.10 (s, 3H, -CH(_3)-C-OH), 1.20 (s, 3H, -CH(_3)-CO-COH), 1.25-2.04 (m, 30H), 2.45-2.62 (m, 4H, alpha to &gt;C=O).</td>
<td>20.72 (C-4 &amp; C-8), 23.65 (C-3 &amp; C-9), 23.77 (C-4' &amp; C-8'), 24.23 (C-3' &amp; C-9'), 28.45 (C-11), 31.34 (C-11'), 35.68 (C-5 &amp; C-7), 39.35 (C-5' &amp; C-7'), 40.45 (C-2' &amp; C-10'), 42.19 (C-2 &amp; C-10), 73.09 (C-6), 76.47 (C-6'), 101.58 (C-1'), 215.10 (C-1).</td>
<td>1.01 (s, 3H, -CH(_3)-C-OH), 1.11 (s, 3H, -CH(_3)-CO-COH), 1.28-1.70 (m, 28H), 2.52-2.67 (m, 4H, alpha to &gt;C=O).</td>
<td>21.81 (C-4 &amp; C-8), 24.95 (C-3 &amp; C-9), 28.81 (C-11), 36.33 (C-5 &amp; C-7), 43.58 (C-2 &amp; C-10), 75.53 (C-6), 224.82 (C-1).</td>
<td>1003, 1028, 2068, 1105, 1131, 1373, 1474, 1706 (&gt;C=O(<em>{as})), 2863, 2932, 3432 (-OH(</em>{as})).</td>
<td>184</td>
</tr>
<tr>
<td>5</td>
<td><img src="image" alt="Diagram of Compound 5" /></td>
<td>1.03 (s, 3H, -CH(_3)-C-OH), 1.04 (s, 3H, -CH(_3)-CO-COH), 1.25-1.78 (m, 25H), 2.77 (bs, 1H, -OH).</td>
<td>20.90 (C-4 &amp; C-8), 23.73 (C-3 &amp; C-9), 24.37 (C-3', C-4' &amp; C-8', C-4' &amp; C-9'), 28.65 (C-11), 31.53 (C-11'), 35.95 (C-5 &amp; C-7), 39.35 (C-5' &amp; C-7'), 41.80 (C-2' &amp; C-10', weak cluster), 42.38 (C-2 &amp; C-10, weak cluster), 73.48 (C-6), 76.89 (C-6'), 101.70 (C-1'), 215.40 (C-1).</td>
<td>20.90 (C-4 &amp; C-8), 23.73 (C-3 &amp; C-9), 24.37 (C-3', C-4' &amp; C-8', C-4' &amp; C-9'), 28.65 (C-11), 31.53 (C-11'), 35.95 (C-5 &amp; C-7), 39.35 (C-5' &amp; C-7'), 41.80 (C-2' &amp; C-10', weak cluster), 42.38 (C-2 &amp; C-10, weak cluster), 73.48 (C-6), 76.89 (C-6'), 101.70 (C-1'), 215.40 (C-1).</td>
<td>21.70 (C-4 &amp; C-8), 24.76 (C-3 &amp; C-9), 28.67 (C-11), 36.26 (C-5 &amp; C-7), 42.93 (C-2 &amp; C-10, weak cluster), 75.67 (C-6), 225.45 (C-1).</td>
<td>1025, 1118, 1261, 1376, 1448, 1702 (&gt;C=O(<em>{as})), 2862, 2930, 3423 (-OH(</em>{as})).</td>
<td>211 (M+Na(^+))</td>
</tr>
</tbody>
</table>

\(^1\)Chemical shift values are expressed as \(\delta\) values (ppm) downfield from tetramethylsilane as internal standard for CDC\(\text{Cl}_3\) solutions while in D\(\text{2}O\) the shifts are expressed as \(\delta\) values (ppm) considering resonance of C-OH as reference. \(^2\)Chemical shift values are expressed as \(\delta\) values (ppm) using deuterated chloroform (CDC\(\text{Cl}_3\)) as internal standard while in D\(\text{2}O\) the shifts are given in ppm considering resonance of C-OH as reference.
6-(1,1,1-triphenylmethoxy)cyclodecane (4) was synthesized from 6-hydroxycyclodecane (1) by procedure similar to the one described by Chaudhary and Hernandez for the synthesis of triphenylethers of cyclohexanol (details will be discussed in chapter 3).\textsuperscript{32} Keto-ether 4 when heated under reflux with K\textsubscript{2}CO\textsubscript{3} and D\textsubscript{2}O (1:2:20 mole ratio) in DME provided 2,10-tetradeuterated-6-(1,1,1-triphenylmethoxy)cyclodecane (6). The \textsuperscript{1}H NMR of 4 (in CDCl\textsubscript{3}) exhibits a multiplet at \(\delta 2.16\) ppm corresponding to protons alpha to carbonyl moiety, in the product this multiplet diminished indicating the replacement of these protons by the deuterium atoms.

**Table 23.** \textsuperscript{1}H NMR\textsuperscript{1}, \textsuperscript{13}C NMR\textsuperscript{2} and Mass Spectral data of 6-(1,1,1-triphenylmethoxy)cyclodecane (4) and 2,2,10,10-d\textsubscript{4}-6-(1,1,1-triphenylmethoxy)cyclodecane (6).

<table>
<thead>
<tr>
<th>Compound</th>
<th>Spectrum</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>OCPH\textsubscript{3}</td>
</tr>
<tr>
<td>6</td>
<td>OCPH\textsubscript{3}</td>
</tr>
</tbody>
</table>

\textsuperscript{1}H NMR (300 MHz, in CDCl\textsubscript{3})

<table>
<thead>
<tr>
<th>4</th>
<th>1H NMR (300 MHz, in CDCl\textsubscript{3})</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1.29-1.44 (m, 10 H), 1.63-1.71 (m, 2H), 2.07-2.30 (m, 4H, alpha to carbonyl), 3.38-3.41 (t, 1H, -CH-OCPh\textsubscript{3}, J=5 Hz), 7.18-7.29 (m, 9H), 7.46-7.50 (m, 6H).</td>
</tr>
<tr>
<td>6</td>
<td>1.25-1.38 (m, 10 H), 1.62-1.65 (m, 2H), 3.38-3.41 (t, 1H, -CH-OCPh\textsubscript{3}), 7.14-7.46 (m, 15 H, aromatic).</td>
</tr>
</tbody>
</table>

\textsuperscript{13}C NMR (300 MHz, in CDCl\textsubscript{3})

<table>
<thead>
<tr>
<th>4</th>
<th>\textsuperscript{13}C NMR (300 MHz, in CDCl\textsubscript{3})</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>22.38 (C-4 &amp; C-8), 23.21 (C-3 &amp; C-9), 31.41 (C-5 &amp; C-7), 41.38 (C-2 &amp; C-10), 72.22 (C-6), 86.15 (C-11), 126.99, 127.61, 129.01, 145.77, 214.69 (C-1).</td>
</tr>
<tr>
<td>6</td>
<td>22.28 (C-4 &amp; C-8), 23.03 (C-3 &amp; C-9), 31.37 (C-5 &amp; C-7), 72.24 (C-6), 86.16 (C-11), 126.87, 127.25, 127.56, 127.92, 129.38, 146.87.</td>
</tr>
</tbody>
</table>

Mass Spectrum (m/z)

| 4 | 412 |
| 6 | 439 (M+Na\textsuperscript{+}) |

\textsuperscript{1}Chemical shift values are expressed as \(\delta\) values (ppm) downfield from tetramethylsilane as internal standard for CDCl\textsubscript{3} solutions. \textsuperscript{2}Chemical shift values are expressed as \(\delta\) values (ppm) using deuterated chloroform (CDCl\textsubscript{3}) as internal standard.
In $^{13}$C NMR, the peak corresponding to the C-2 and C-10 (at $\delta$ 41.38 ppm in CDCl$_3$) turned out to be a weak cluster indicating the presence of deuterium atoms at these positions (Table 2.3). The LRCIMS displayed the (M+Na$^+$) peak at 439 for 6 inferring thereby the presence of four deuterium atoms.

CONCLUSIONS

The work herein discloses a medium ring compound 6-hydroxycyclodecanone (1) to be a unique entity, which despite of the flexible conformation has a tendency to undergo intra-molecular redox reaction under very mild acidic and basic conditions. With the aid of deuteration studies, it has been proved that $\delta$-ketol rearrangement in this system leads to reduction of the carbonyl moiety by a hydride from C-6, while the hydroxyl at C-6 gets oxidized to the keto in the presence of catalytic amount of acid as well as base. The insight gained into such hydride shifts is extremely important and is expected to have considerable implications as far as exploitation of this system towards natural products is concerned.
EXPERIMENTAL

6-Hydroxycyclodecanone (1). The compound was synthesized from a mixture of cis- and trans-decalin in four steps by the procedure reported in Chapter 1, pp 60-62.

2,2,5,5,7,7,10,10-d8-6-hydroxycyclodecanone (2, In the presence of acid using microwaves): A solution of 6-hydroxycyclodecanone (50 mg, 0.29 mmol) and DCI (551.2 µg, 0.015 mmol) in D2O (0.5 mL) was placed in a test tube (20 mL). The test tube was exposed to MWI (660 W) for 10 min. The reaction mixture was dissolved in ether (10 mL), washed with water (5 mL) and NaHCO3 solution (5%, 5mL). The ether layer was dried (Na2SO4) and evaporated to give solid (52 mg, 99%), m.p. 68-69°C. The spectral data is as given in Table 2.1.

To calculate the percentage deuterium incorporation29 in 2 the following method was used.

Peak heights in unlabelled standard (arbitrary units).

<table>
<thead>
<tr>
<th>Mass</th>
<th>M</th>
<th>M+1</th>
<th>M+2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>1</td>
<td>0.696</td>
<td>0.087</td>
</tr>
</tbody>
</table>

Peak heights in unlabelled standard (arbitrary units).

<table>
<thead>
<tr>
<th>Mass</th>
<th>M+5</th>
<th>M+6</th>
<th>M+7</th>
<th>M+8</th>
<th>M+9</th>
<th>M+10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>7</td>
<td>16</td>
<td>40</td>
<td>43</td>
<td>22</td>
<td>7</td>
</tr>
</tbody>
</table>

\[ I_{M+5} = 7. \]
\[ I_{M+6} = 16 - (7 \times 0.696) = 11.13. \]
\[ I_{M+7} = 40 - (11.13 \times 0.696) - (7 \times 0.87) = 31.64. \]
\[ I_{M+8} = 16 - (31.64 \times 0.696) - (11.13 \times 0.087) = 20.01. \]
\[ I_{M+9} = 22 - (20.01 \times 0.696) - (31.64 \times 0.087) = 5.32. \]
\[ I_{M+10} = 7 - (5.32 \times 0.696) - (20.01 \times 0.087) = 1.56. \]

Sum of corrected intensities = 7 + 11.13 + 31.64 + 20.01 + 5.32 + 1.56 = 76.66.

Mole % of (M+5) = \( \frac{7}{76.66} \times 100 = 9.13. \)

Mole % of (M+6) = \( \frac{11.13}{76.66} \times 100 = 14.52. \)

Mole % of (M+7) = \( \frac{31.64}{76.66} \times 100 = 41.60. \)

Mole % of (M+8) = \( \frac{20.01}{76.66} \times 100 = 26.10. \)

Mole % of (M+9) = \( \frac{5.32}{76.66} \times 100 = 6.94. \)

Mole % of (M+10) = \( \frac{1.56}{76.66} \times 100 = 2.03. \)

The presence of 9.13 mole% penta, 14.52 mole% hexa, 41.60 mole% hepta, 26.10 mole% octa, 6.94 mole% nano and 2.03 mole% deca deuterated species is indicated.

2,2,5,5,7,7,10,10-\text{d}_6-6\text{-hydroxycyclodecanone} (2, \text{In the presence of acid at room temperature}): 6-hydroxycyclodecanone (50 mg, 0.29 mmol) was dissolved in D\textsubscript{2}O (0.5 mL) in a dry NMR tube. DCI in D\textsubscript{2}O (551.2 \mu g, 0.015 mmol) was added via micropipette at 0°C, and the tube was capped and kept at room temperature. The spectra were recorded at time interval of 24 h. After 9 days the \textsuperscript{1}H NMR revealed the presence of 66% deuterated product 2 (the ratio was calculated on the basis of integration of the relative area corresponding to the remaining protons alpha to carbonyl).

6-methyl-6-hydroxycyclodecanone (3). The compound was synthesized from 6-hydroxycyclodecanone as reported in Chapter 1, pp 66.
6-(1,1,1-triphenylmethoxy)cyclodecanone (4). The compound was synthesized from 6-hydroxycyclodecanone as reported in Chapter 3, pp 124.

General procedure for the deuteration of alcohols and ether (in the presence of base): All reactions were carried out in the presence of nitrogen. A mixture of ketones (1 equiv.), potassium carbonate (2 equiv.) and deuterium oxide (20 equiv.) was heated under reflux.

2,2,5,5,7,7,10,10-d6-6-hydroxycyclodecanone (2). The general procedure was followed using 200 mg (1.18 mmol) of 1, 324 mg of potassium carbonate (2.35 mmol) and 470 mg of deuterium oxide (23.5 mmol). After 72 h the reaction mixture was extracted with ether (3 x 10 mL) and the combined organic layer was dried (Na2SO4). The removal of solvent yielded a solid (209 mg, 100%). The spectral features of the product are as described in Table 2.1.

2,2,10,10-d4-6-methyl-6-hydroxycyclodecanone (5). The general procedure was followed using 3 (100 mg, 0.54 mmol), potassium carbonate (150 mg, 1.09 mmol) and deuterium oxide (217 mg, 10.9 mmol). After 48 h the reaction mixture was extracted with ether (3 x 10 mL) and the combined organic layer was dried (Na2SO4). The removal of solvent yielded colorless oil (103 mg, 100%). The spectral properties are reported in Table 2.2.

2,2,10,10-d4-6-(1,1,1-triphenylmethoxy)cyclodecanone (6): The general procedure was followed using 4 (100 mg, 0.24 mmol), potassium carbonate (67 mg, 0.49 mmol) and deuterium oxide (97 mg, 4.85 mmol) in DME (1 mL). After 48 h the solvent was removed under reduced pressure and reaction mixture was extracted with ether (2 x 10 mL). The combined organic layer was dried (Na2SO4). The removal of solvent yielded 2,10-tetra deuterated-6-(1,1,1-triphenylmethoxy)cyclodecanone (6) as a solid (80 mg, 80%); m.p. 164-166°C. The spectral properties are reported in Table 2.3.
REFERENCES


