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REACTIONS OF SOME α-ACYLIMMONIUM IONS

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Abstract - The reactions of various hydroxylactams proceeding *via* α-acylimmonium ions are described.

The reductive N-cyclization of lactamoester 1 with $LiAlH_4$ at -70°C¹⁾ or $LiAlH(O\text{-}t\text{-}But)_3$ at room temperature resulted in the formation of two pairs of hydroxylactams 3a, 3b, 5a and 5b. The same result was obtained in the case of imide 2 reduction. The cyclic hydroxylactams have recently been found as a new class of precursors for the highly reactive α-acylimmonium ion and therefore have a variety of applications$^{2,3)}$. In the present communication we report the properties of some α-acylimmonium ions.

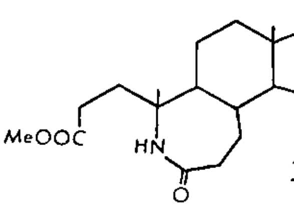
Compounds 3a or 3b in THF solution, treated with a drop of 60% $HClO_4$ at room temperature (30 min), afforded unsaturated lactam 4 (m.p. 133-135°C, $[\alpha]_D^{24}$ +154.6°; 65%) together with the starting materials 3a (5%) + 3b (15%). The reaction mixture composition was not significantly altered upon prolonging the reaction time for 3 h. It should be added that unsaturated lactam 4, treated with a drop of 60% $HClO_4$ in THF, resulted in the identical equilibration between the substrate and hydroxylactams 3a + 3b.

In the case of the reaction of hydroxylactams 5a or 5b with perchloric acid the corresponding dehydrated product 6 was not formed, but only the epimerization of hydroxylactams 5a ⇄ 5b (70% and 18%, respectively) was observed. It is likely, therefore, that the dehydration process of these hydroxylactams is unfavourable due to the comparatively high strain of the unsaturated five-membered ring system. However, unsaturated lactam 6 (m.p. 126-128°C, $[\alpha]_D^{24}$ +97.6°) was obtained by prolonged heating of hydroxylactams 5a or 5b in boiling pyridine. Under the same conditions hydroxylactams 3a or 3b also underwent almost quantitative dehydration to give compound 4. Unsaturated lactam 6 in THF solution under acid conditions ($HClO_4$) was immediately transformed into the equilibrium mixture of hydroxylactams 5a and 5b in the ratio 4 : 1.

We suppose that all reactions of hydroxylactams with an acid have occurred via stabilized α-acylimmonium ion (A or B), which could lose a proton or to which a molecule of water could be added. This has been supported by methylation of hydroxylactams with methanol in the presence of small amounts of pyridine hydrochloride at room temperature. Under these conditions both hydroxylactams 5a and 5b formed one and the same product, α-methyl ether 5c (m.p. 115-117°C, $[\alpha]_d^{25}$ +67.0°). Hydroxylactams 3a and 3b, rather unexpectedly, afforded 6β-methoxy-steroid 3c (an oil, $[\alpha]_D^{25}$ +96.0°) as the main product. In return the transformation OMe → OH proved also to be possible. On treatment of 5c in THF with $HClO_4$ at room temperature a mixture of hydroxylactams 5a and 5b was obtained in almost quantitative yield. Under the same conditions methoxylactam 3c afforded unsaturated lactam 4 (65%) and hydroxylactams 3a + 3b.

Further evidence of the α-acylimmonium ion formation in acid medium was provided by reactions of lactamodiol 7[4]. Treatment of 7 with perchloric acid in THF solution afforded epoxylactam 8 (m.p. 193-195°C, $[\alpha]_D^{17}$ +75.7°). The unusual closure to an oxirane ring from cis diol confirmed the formation of the well defined α-acylimmonium ion C in the first step of the reaction. The reaction of lactamodiol 7 with $HClO_4$ carried out in acetone solution afforded compound 9 (m.p. 89-90°C, $[\alpha]_D^{17}$ +45.1°) containing a dioxolane ring. The compound 9 was also formed from epoxylactam 8 under acid conditions in acetone solution.

In the case of the reaction of isomeric lactamodiol 10[4] with perchloric acid in THF the product was unsaturated alcohol 11 (138-142°C, $[\alpha]_D^{19}$ -23.4°). The corresponding epoxide was not detected. On the other hand, lactamodiol 10 treated in THF solution with hydrochloric acid (room temperature, 12 h) afforded aldehyde 12 (129-132°C, $[\alpha]_D^{17}$ -54.6°). The same product was obtained from compound 11 under the above conditions. The formation of aldehyde 12 from lactamodiol 10 probably proceeded via the intermediary unsaturated alcohol 11 which could be detected by TLC.



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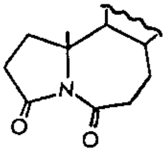

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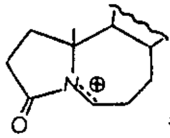

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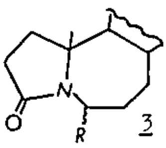

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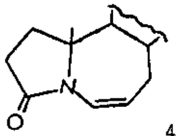
b: R=β-OH
c: R=β-OMe



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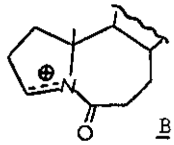

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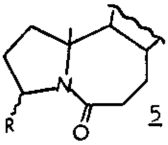

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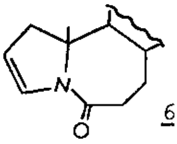
b: R=β-OH
c: R=α-OMe



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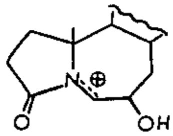

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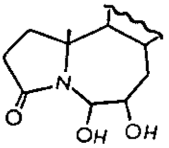

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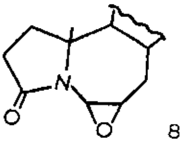

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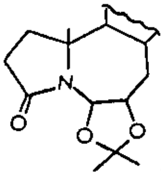

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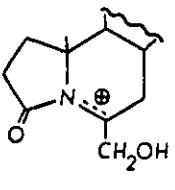

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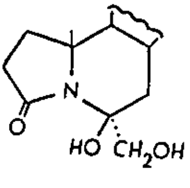

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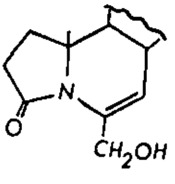

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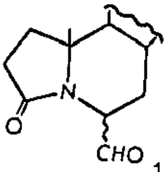

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