

Synthesis of 2-Acetamido-2-deoxy-5,6-*O*-ethylidene-D-mannose

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As part of our studies on potential inhibitors of *Vibrio cholerae* neuraminidase, the 7,9-*O*-ethylidene derivative of *N*-acetylneuraminic acid was recently prepared.¹ In the present paper, the synthesis of 2-acetamido-2-deoxy-5,6-*O*-ethylidene-D-mannose is reported. An attempted synthesis of the 8,9-*O*-ethylidene derivative of *N*-acetylneuraminic acid from this product was not successful, owing to hydrolysis of the acetal group during the reaction.

2-Acetamido-2-deoxy-D-mannono-1,4-lactone² was converted into the 5,6-*O*-ethylidene derivative. Attempted reduction of this lactone, or its trimethylsilyl derivative to the corresponding aldose derivative using lithium aluminium hydride, lithium triethoxyaluminium hydride, sodium amalgam or catalytic hydrogenation was not successful. The reduction with sodium borohydride at pH 3–4³ was slow, but by using a large excess of reagent, an acceptable yield of 2-acetamido-2-deoxy-5,6-*O*-ethylidene-D-mannose was obtained.

The IR and NMR spectra of the 5,6-*O*-ethylidene derivatives of 2-acetamido-2-deoxy-D-mannono-1,4-lactone and 2-acetamido-2-deoxy-D-mannose were in accordance with the proposed structures. The latter substance after silylation was subjected to GLC-MS which revealed, *inter alia*, fragments at 391 m.u. (weak) and 375 m.u., corresponding to M^+ and $M^+ - 15$, respectively.

Oxidation of the lactone derivative with lead tetraacetate in pyridine⁴ produced a carbonyl derivative. A negative reaction with Schiff's reagent and the absorption at 1716 cm^{-1} in the IR demonstrated the presence of a keto group rather than an aldehyde group. Thus we may conclude that the acetal group occupies positions 5 and 6 and not positions 3 and 5.

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Experimental. The same general methods were used as previously reported.¹

*2-Acetamido-2-deoxy-5,6-*O*-ethylidene-D-mannono-1,4-lactone.* 2-Acetamido-2-deoxy-D-mannose was prepared from 2-acetamido-2-deoxy-D-glucose as described by Kuhn and Baschang.⁵ After purifying by chromatography on a silica gel column using anhydrous ethanol as solvent, it was converted into the lactone as described by Pravdić and Fletcher.² The crude lactone, in ethanol, was treated with DEAE-Sephadex A 25 (free base), concentrated and crystallized from ethanol, to give the pure lactone, m.p. 177–178°, $[\alpha]_D^{24} + 78^\circ$ (c 1.0 water). Pravdić and Fletcher report m.p. 172–173°, $[\alpha]_D + 87.4$ (c 1.0 water).

A mixture of acetonitrile (20 ml), paraldehyde (6.0 ml) 2-acetamido-2-deoxy-D-mannono-1,4-lactone (2.0 g) and conc. hydrochloric acid (200 μl) was stirred at room temperature. The mixture became homogeneous after about 20 min, and shortly afterwards crystals began to appear. After 3 h, the crystals (1.0 g) were filtered off, washed with acetonitrile and dried. A second crop (0.7 g) was obtained from the filtrate and washings after neutralisation with DEAE-Sephadex A25 (free base) and concentration. Crystallization from methanol yielded the pure lactone, m.p. 225–226°, $[\alpha]_D^{24} + 100$ (c 0.33 methanol). (Found: C 49.0; H 6.2; N 5.8. $\text{C}_{10}\text{H}_{15}\text{NO}_6$ requires C 49.0; H 6.16; N 5.71.)

*2-Acetamido-2-deoxy-5,6-*O*-ethylidene-D-mannono-1,4-lactone.* 2-Acetamido-2-deoxy-5,6-ethylidene-D-mannono-1,4-lactone (1.0 g) was dissolved in a mixture of ethanol-water (1:5, 120 ml) and the solution was cooled to -10° with a dry ice-ethanol mixture bath. A pH-electrode and a thermometer were immersed in the solution.

Sodium borohydride (30 g) dissolved in water (300 ml) and a mixture of ethanol and 1 M sulfuric acid (1:5), were added simultaneously to the solution at such a rate that the temperature was kept at -10° and the pH-value of the mixture between 3 and 4. Stirring was maintained during the additions. After the last addition of borohydride, the reaction mixture was allowed to reach room temperature. The pH of the solution was adjusted to 7.0 with 2 M sodium hydroxide and the solution was concentrated to dryness. The resulting solid was extracted with methanol (8 \times 25 ml) and the extract was treated with a mixture of DEAE-Sephadex A 25 (free base) and SE-Sephadex SE 25 (H^+)⁶ to remove sodium and sulphate ions. The solution was concentrated and the boric acid in the residue removed by repeated distillation with methanol. On concentration of the solution, the product was obtained as a glass (0.6 g) which crystallized

from ethyl acetate-butanol (1:1). The product, m.p. 165–175° (decomp.), showed $[\alpha]_D^{25} +75$ (c 1.0 water), with no mutarotation, indicating that it is a mixture of anomers, (Found: C 48.6; H 6.7; N 5.6. $C_{10}H_{17}NO_6$ requires C 48.6; H 6.9; N 5.7.)

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On the Crystal Structure of $RhMg_{\sim 6}$

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According to Ferro the phases $PdMg_{5.6-6.9}$ ¹ and $PtMg_{\sim 6}$ ² are isotypic with a cell edge $a \approx 20.1$ Å. No further data on the crystal structure have been reported. In the course of phase analysis and crystal structure studies on the platinum metal-magnesium systems a similar compound has also been found in the Rh–Mg system. Phase analysis of powder patterns obtained from samples of different compositions

around $RhMg_6$ and examinations of single crystals showed that a crystal obtained from a sample somewhat higher in magnesium than 1:6 ratio ($RhMg_{6.3}$) was best suited for a further single crystal study.

The alloy $RhMg_{6.3}$ was prepared from weighed amounts of the components by melting in a sealed iron tube. The tube was heated to 1150°C, slowly cooled (3°C per hour) to 500°C and then quenched in water to room temperature. The specimen thus prepared showed no contamination of iron when chemically analyzed. The Guinier powder photograph of the product showed no extra lines and the pattern could be indexed assuming a cubic unit cell with $a = 20.148 \pm 1$ Å.

A single crystal formed as a cube (the edge less than 0.1 mm) was mounted on a single-crystal X-ray diffractometer and 710 independent reflections ($\theta \leq 31^\circ$) were collected with $MoK\alpha$ radiation. The systematic absences were consistent with space groups $Fm\bar{3}m$, $F\bar{4}3m$, and $F432$.

A trial structure was derived by using a Samson packing map³ obtained from the symmetry of the (110)-plane of space group $F\bar{4}3m$. The structure was assumed to be built up by icosahedra of magnesium atoms surrounding a rhodium atom. Regular icosahedra with an edge of 3 Å were fitted together on the packing map. In this way the approximate positions of three rhodium and eleven magnesium atoms were found.

The atomic parameters thus obtained were taken as starting values in a least squares refinement. An R -value of 0.085 was obtained. The final structural data corresponding to the formula Rh_7Mg_{44} are given in Table 1.

All the rhodium atoms are surrounded by twelve magnesium atoms forming an icosahedron. The Rh(1)–Mg, Rh(2)–Mg, and Rh(3)–Mg distances are in the ranges 2.65–3.16, 2.72–3.10, and 2.82–2.99 Å, respectively. Four icosahedra of Rh(3) share corners and these corners form an octahedron with the center at $\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$. This part of the structure is also found in the structure of $VALi_6$.⁴ Four icosahedra of Rh(2) share faces and form a complex of atoms similar to an arrangement found in the gamma phase structure.⁵ Six icosahedra of Rh(1) share faces and this arrangement results in very deformed icosahedra with a great variation in the Rh–Mg distances. The very short distance 2.65 Å may be compared with another short palladium