The Acyloin Condensation, Applied to Dimethyl Galactarate

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Acyloin condensation of a hexaric acid ester, in which the hydroxyl functions are suitably protected, should give an inosose derivative. This, however, should most probably not be stable under the strongly alkaline conditions of the synthesis. In recent publications [1,2] acyloin condensations in the presence of trimethylchlorosilane are reported. The reaction product under these conditions is not the acyloin but the alkali-stable trimethylsilylated enediol. In the present paper an attempt to prepare an inosose by this modified procedure is reported.

Dimethyl galactarate was transformed into the crystalline tetra-*O*-trimethylsilyl derivative. This substance, in toluene, was reacted with a stoichiometrical amount of sodium and an excess of trimethylchlorosilane. The excess of the latter reagent was employed to compensate for losses by evaporation, as a slow stream of nitrogen was passed through the reaction flask. The reaction mixture was worked up to give starting material (62 %) and 1,2-di-trimethylsilyloxybenzene (18 %). This shows that coupling has occurred, but that the coupling product has reacted further by consecutive eliminations and reductions, to yield the stable 1,2-dihydroxybenzene derivative. A considerable amount of the sodium must have been consumed in these reactions, which accounts for the low percentage of cyclic product.

Experimental. Dimethyl tetra-O-*trimethylsilyl-galactarate (1).* Dimethylgalactarate [3] (23.8 g) was dissolved in dry pyridine (300 ml) and trimethylchlorosilane (49 g) was added. The mixture was shaken for 12 h at room temperature. Pyridine hydrochloride was removed by filtration and washed with small portions of pyridine. The combined filtrates were concentrated under reduced pressure to yield a crystalline mass. Recrystallisation from ether yielded pure 1 (41 g, 78 %), m.p. 110–111° (Found C 45.5; H 8.72. $C_{20}H_{46}O_8Si_4$ requires: C 45.6; H 8.80).

Reaction of 1 with sodium and trimethylchlorosilane. Pure toluene (60 ml) and clean sodium (4.6 g, 0.2 mole) were placed in a 250 ml four-necked flask equipped with a high-speed stirrer, reflux condenser, dropping funnel and gas inlet tube. During the whole procedure a slow stream of nitrogen was passed through the system. The solution was heated to boiling and the sodium dispersed by stirring at about 2000 rpm. After cooling to room temperature a solution of trimethylchlorosilane (30.4 g, 0.3 mole) and 1 (26.4 g, 0.05 mole) in toluene (70 ml) was added. The mixture was heated to 90° and kept at this temperature for 4.5 h, at which time all the sodium had disappeared. Precipitated material was removed by filtration and washed with toluene. The combined filtrates were concentrated under reduced pressure to give a crystalline mass. Recrystallisation from ether yielded pure 1 (16.2 g, 62 %), m.p. 110–111°. Concentration of the mother liquors and vacuum distillation yielded 1,2-di-trimethylsilyloxybenzene (2), (2.3 g, 18 %), b.p. 61–65°/0.7 mm Hg. The NMR spectrum of 2 showed the expected absorption at δ 7.05 and δ 0.15, in the ratio of 1:4.5. A sample of 2, in aqueous methanol (1:2), was refluxed overnight, concentrated to dryness and treated with acetic anhydride-sulphuric acid to yield a substance, m.p. 64°–64.5°, undistinguishable from authentic 1,2-diacetoxybenzene (mixed m.p., IR).

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