Notes

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Method for the Cleavage of Osmate Esters

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Osmate esters obtained in the oxidation of alkenes with osmium tetroxide have been cleaved with reagents such as strong aqueous base and mannitol,[1] refluxing aqueous alcoholic sodium sulfite[2] or bisulfite,[3] and hydrogen sulfide.[4] This communication describes a method for the smooth transformation of osmate esters to *cis*-glycols under mild conditions which avoid the often troublesome separation of product from osmium or its inorganic derivatives.

In this modified technique an osmate ester which is prepared in pyridine is stirred at room temperature for 5 to 30 minutes with a solution of sodium bisulfite and aqueous pyridine. The clear orange solution which results contains the *cis*-glycol and a soluble osmium salt. Extraction of the aqueous pyridine solution with chloroform yields a colorless chloroform and pyridine solution which contains only the *cis*-glycol. By this method 3β-hydroxyandrost-5-en-17-one, 17-vinyltestosterone, and ouabagenin tetraacetate have been oxidized to glycols in crude yields of 86, 72, and 81%, respectively.

EXPERIMENTAL

General procedure. A 3.9-mmol. sample of the alkene to be oxidized was dissolved in 15 ml. of pyridine and stirred with 1.0 g. (3.94 mmol.) of osmium tetroxide for an appropriate time. To this mixture was added with stirring a solution of 1.8 g. of sodium bisulfite, 30 ml. of water, and 20 ml. of pyridine. The ratio of sodium bisulfite, and water, and pyridine in the final mixture should be about 2:30:35. When a clear orange solution was obtained (5 to 30 min.), it was extracted thoroughly with chloroform. The chloroform extract was dried over potassium carbonate or sodium sulfate and evaporated to dryness *in vacuo* to yield the product.

3β,5α,6α-Trihydroxyandrostan-17-one.[5] A solution of 1.14 g. (3.9 mmol.) of 3β-hydroxyandrost-5-en-17-one, 1.0 g. (3.94 mmol.) of osmium tetroxide and 15 ml. of pyridine was stirred for 2 hr. The mixture was then stirred for 5 min. with a solution of 1.8 g. of sodium bisulfite, 30 ml. of water, and 20 ml. of pyridine. The orange solution which was obtained was extracted with one 150-ml. and two 50-ml. portions of chloroform. The combined organic extract was dried over potassium carbonate and evaporated to dryness *in vacuo*. The crude crystalline product was triturated with ethyl acetate, collected by filtration, and dried. It weighed 1.05 g. (86%) and melted at 240–243°.

17,20ϵ,21ϵ-Trihydroxy-17α-pregn-4-en-3-one.[6] A solution of 3 g. (9.65 mmol.) of 17-vinyltestosterone, 3.0 g. (11.8 mmol.) of osmium tetroxide and 60 ml. of pyridine was stirred in the dark for 20 hr. To the mixture was added with stirring a solution of 5.6 g. of sodium bisulfite, 90 ml. of water, and 45 ml. of pyridine. The solution was then extracted thoroughly with chloroform. The chloroform extract was washed with water, dilute hydrochloric acid, water, and aqueous sodium bicarbonate, dried over sodium sulfate, and evaporated to dryness *in vacuo*. Crystallization of the residue from methanol yielded 2.5 g. (72%) of product which melted at 186–193°.

1β,3β,5β,11α,14,19,20ϵ,22ϵ-Octahydrcxycardanolide-1,3,11,-19-tetraacetate. A solution of 2.2 g. (3.25 mmol.) of ouabagenin-1,3,11,19-tetraacetate,[7] 1.0 g. (3.94 mmol.) of osmium tetroxide and 20 ml. of pyridine was stirred for 1 day. The mixture was then stirred for 30 min. with a solution of 1.8 g. of sodium bisulfite, 30 ml. of water, and 15 ml. of pyridine. The solution was extracted thoroughly with chloroform. The chloroform extract was washed with water, dilute hydrochloric acid, water, and aqueous sodium bicarbonate, dried over sodium sulfate, and evaporated to dryness *in vacuo*. Crystallization of the residue from ethyl acetate yielded a crude product which melted at 285–290° and weighed 1.7 g. (81%). An analytical sample prepared by crystallization of the crude product from methanol melted at about 318°.

Anal. Calcd. for $C_{31}H_{44}O_{14}$: C, 58.11; H, 6.92. Found: C, 57.86; H, 7.07.

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Aliphatic Nitriles from Alkyl Chlorides

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The preparation of nitriles by the reaction of primary alkyl halides with alkali metal cyanides is an old and well known procedure. However, alkyl chlorides, except for benzyl- or allyl-type compounds, have not been used very frequently because of excessive reaction times required with the aqueous alcohol solvent usually used for this type reaction.[1] Other solvent systems, such as ethylene glycol monomethyl ether[2] or polyethylene glycol,[3]

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