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A NEW REAGENT FOR THE SELECTIVE OXIDATION OF STEROIDAL ALLYLIC ALCOHOLS TO αβ-UNSATURATED KETONES

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IN a previous communication[1] we reported the conversion of steroidal 4-en- and 4,6-dien-3-ones into the corresponding 1,4-dien and 1,4,6-trien-3-ones by the use of 2,3-dichloro-5,6-dicyanobenzoquinone (DDQ).[2] We now find that DDQ selectively oxidizes steroidal allylic alcohols to the corresponding αβ-unsaturated ketones in excellent yield.* The reaction is conveniently performed at room temperature by adding a slight excess of DDQ dissolved in dry benzene or dioxan to a solution of the steroid in the same solvent. Precipitation of the hydroquinone begins almost immediately and the reaction is generally complete within 5 - 15 hr. Under these conditions 1,2-dehydrogenation[1] does not occur and saturated alcohols are completely unaffected.

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* Braude et al.[3] have described the oxidation of cholest-4-en-3β-ol to the 3-one using chloranil; the yield is however lower than that obtained with DDQ.

1 D. Burn, D.N. Kirk and V. Petrow, Proc. Chem. Soc. 14 (1960).

2 E.A. Braude, A.G. Brook and R.P. Linstead, J. Chem. Soc. 3569 (1954).

3 E.A. Braude, R.P. Linstead and K.R. Wooldridge, J. Chem. Soc. 3070 (1956).

In addition, none of the other functional groups commonly encountered in steroid chemistry appear to be attacked by the reagent under the above experimental conditions. The hydroquinone formed during the reaction may be recovered and re-oxidized to DDQ if desired. In terms of speed and reproducibility, this reagent appears to offer advantages over manganese dioxide which has hitherto been employed for this purpose.[4]

The following transformations give some indication of the scope of the reaction:-

Androst-4-ene-3β,17β-diol 17β-hydroxyandrost-4-en-3-one (70%)

Androsta-1,4-diene-3β,17β-diol 17β-hydroxyandrosta-1,4-dien-3-one (45%)

Androsta-4,6-diene-3β,17β-diol 17β-hydroxyandrosta-4,6-dien-3-one (70%)

Androsta-1,4,6-triene-3β,17β-diol 17β-hydroxyandrosta-1,4,6-trien-3-one (50%)

Pregna-5,16-diene-3β,20β-diol 3β-hydroxypregna-5,16-dien-20-one (75%)

Pregn-4-en-3β,20β-diol 20β-hydroxypregn-4-en-3-one (70%)

Pregn-4-ene-3β,11β,20β-triol 11β,20β-dihydroxypregn-4-en-3-one (70%)

Cholest-5-ene-3β,4β-diol Cholestane-3,4-dione (via 3β-hydroxycholest-5-en-4-one) (75%)

Cholest-4-ene-3β,6β-diol 6β-hydroxycholest-4-en-3-one (60%)

25D-Spirost-9(11)-ene-3β,12β-diol 3β-hydroxy-25D-spirost-9(11)-en-12-one (70%)

The presence of such substituents as methyl at C_2, C_4 and C_6 does not interfere with the oxidation of allylic-3-ols.

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[4] F. Sondheimer and G. Rosenkranz, Experientia 9, 62 (1953).