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FUNCTIONALIZATION OF AN UNACTIVATED CARBON ATOM IN A TRITERPENE BY DRY OZONATION. A FORMATION OF 15- AND 16-OXOFRIEDELANES

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Dry ozonation of friedelane (1) afforded 18β,19β-epoxyfriedelane (2), 19-oxofriedelane (3), 16-oxofriedelane (5), and a new carbonyl compound, 15-oxofriedelane (4). On SeO_2 oxidation, 4 and 5 gave the same 15,16-dioxofriedelane (6).

Although a number of investigations[1)] on the functionalization of unactivated carbon atoms have been reported in steroid field, only a few investigations[2)] have been carried out in triterpene chemistry, except for the partial conversion[3)] utilizing the Barton reaction and the relating photochemical reactions.

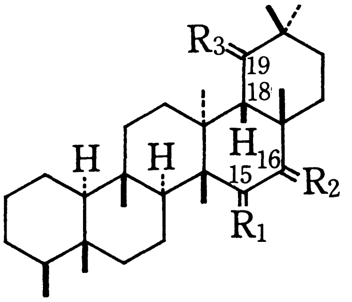
In connection with the studies on functionalization of unactivated carbon atoms of friedelane (1) and its derivatives, dry ozonation, recently developed by Y. Mazur et al.[4)] was applied for the introduction of a functional group into the friedelane framework. In this communication, we wish to report a formation of 15- and 16-oxofriedelanes (4 and 5) together with 18β,19β-epoxyfriedelane (2) and 19-oxofriedelane (3).

Friedelane[5)] (1; 100 mg) was absorbed on silica gel (10 g, Wakogel C 200). This was cooled to -78 °C and saturated with ozone (3 % O_3 in O_2, 40 ml/min, 0.5 h) at the same temperature. After sweeping a large excess of ozone with nitrogen at -60 °C, the reaction mass was placed on the top of a silica gel column. Elution with hexane gave the starting material (1; 82 mg; conversion 18 %).

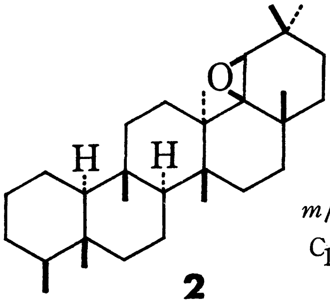
The successive fraction (ca. 19 mg), eluted with benzene, was subjected to separation by preparative TLC to afford 18β,19β-epoxyfriedelane[6)] (2; 9 mg; y. ca. 48 %[7)]), 19-oxofriedelane[6)] (3; 0.4 mg; y. ca. 2 %[7)]), 16-oxofriedelane[8)] (5; 2 mg; y. ca. 11 %[7)]), and a new carbonyl compound (4; 2 mg; y. ca. 11 %[7)]), mp 239-240 °C; $[\alpha]_D$ +38° ($CHCl_3$); CD $[\theta]_{300}$ = -215 (dioxane); IR (Nujol) 1700 cm^{-1}; PMR ($CDCl_3$) an ABq (δ_A 2.15 and δ_B 2.50, J_{AB} = 18 Hz; $\underline{CH_2}$ at C-16); MS m/e (%) 426 (M^+; 19), 411 (90), 393 (64), 355 (10), 302 (20), 221 (54), 194 (100), 177 (20), and 149 (41); MW 426.3874. Calcd for $C_{30}H_{50}O$: MW 426.3862. The PMR spectrum of 4 indicated the presence of a grouping -CO-$\underline{CH_2}$-■ (■ refers to a quaternary carbon atom). PMR measurement using $Eu(fod)_3$-d_{27} and deuterium exchange experiment also supported the presence of the methylene group adjacent to the carbonyl group. The position of the carbonyl group (at C-15 or C-16) was deduced from the fragmentation patterns in the high resolution mass spectrum of 4 (Fig. 1).[9)] These observations led to the conclusion that the structure of 4 should be formulated as 15-oxofriedelane. This received support from the oxidation of 4 with selenium dioxide to give 15,16-dioxofriedelane [6; mp 280-281 °C; IR (Nujol) 1720 and 1700 cm^{-1}; MS m/e (%) 440

(M$^+$; 94), 425 (9), 412 (70), 288 (98), 260 (100), and 177 (53)], which was found to be identical with the diketone obtained from 5 by the same oxidation.

15-Oxofriedelane (4) as well as 16-oxofriedelane (5) would be useful and important key intermediates for the synthesis of friedelane derivatives with substituents in D ring using friedelane (1) as a starting material.



1 $R_1=R_2=R_3=H_2$
3 $R_1=R_2=H_2$; $R_3=O$
4 $R_1=O$; $R_2=R_3=H_2$
5 $R_1=R_3=H_2$; $R_2=O$
6 $R_1=R_2=O$; $R_3=H_2$



2

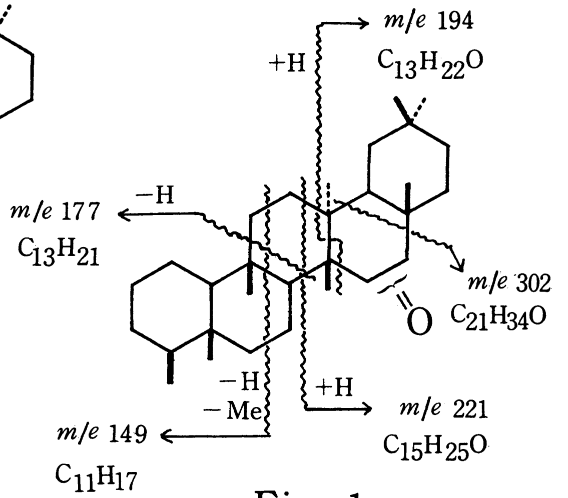


Fig. 1

REFERENCES

1) Cf. R.O.Kan, "Organic Photochemistry," McGraw-Hill, New York, (1966), p. 233; R.Breslow, Chem. Soc. Review, 1, 553 (1972); R.Breslow, S.Baldwin, T.Flechtner, P.Kalicky, S.Liu, and W.Wshburn, J. Am. Chem. Soc., 95, 3251 (1973); R.Breslow, R.J.Corcoran, B.B.Snider, R.J.Doll, P.L.Khanna, and R.Kaleya, ibid., 99, 905 (1977); R.Breslow and L.M.Maresca, Tetrahedron Lett., 1977, 623. And references cited therein. J.E.Baldwin, A.K.Bhatnagar, and R.W.Harper, Chem. Commun., 1970, 659; J.E.Gurst, Y.M.Sheikh, and C.Djerassi, J. Am. Chem. Soc., 95, 628 (1973); P.S.Scholl and M.R. van de Mark, J. Org. Chem., 38, 2376 (1973).
2) R.Kasai, K.Shinzo, O.Tanaka, and K.Kawai, Chem. Pharm. Bull., 22, 1213 (1974).
3) Cf. T.Fukuda, T.Tsuyuki, Y.Tanahashi, and T.Takanashi, Bull. Chem. Soc. Jpn., 38, 1808 (1965); 40, 370 (1967); T.Hoshino, T.Tsuyuki, and T.Takahashi, ibid., 40, 389 (1967); R.B.Boar, L.Joukhadar, M. de Luque, J.F.McGhie, D.H.R.Barton, D.Arigoni, H.G.Brunner, and R.Giger, J. Chem. Soc. Perkin 1, 1977, 2104.
4) H.Varkony, S.Pass, and Y.Mazur, J. Chem. Soc. Chem. Commun., 1974, 437; Z.Cohen, E.Keinan, Y.Mazur, and T.H.Varkony, J. Org. Chem., 40, 2141 (1975); E.Keinan and Y.Mazur, Synthesis, 1976, 523; Z.Cohen, E.Keinan, Y.Mazur, and A.Ulman, J. Org. Chem., 41, 2651 (1976).
5) V.V.Kane and R.Stevenson, Tetrahedron, 15, 223 (1961).
6) T.Tsuyuki, T.Hoshino, M.Ito, and T.Takahashi, Bull. Soc. Chim. Fr., 1968, 2895.
7) Yield calculated based on the converted friedelane (1).
8) T.Kikuchi, M.Takayama, T.Toyoda, M.Arimoto, and M.Niwa, Chem. Pharm. Bull., 21, 2243 (1973); the authors are grateful to Professor T.Kikuchi, Toyama University, for a gift of spectral copies of 16-oxofriedelane (5).
9) Cf. H.Hirota, Y.Moriyama, T.Tsuyuki, Y.Tanahashi, T.Takahashi, Y.Kato, and H. Satoh, Bull. Chem. Soc. Jpn., 48, 1884 (1975).

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