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THE MARKOVNIKOFF HYDROBORATION OF A TRISUBSTITUTED OLEFIN

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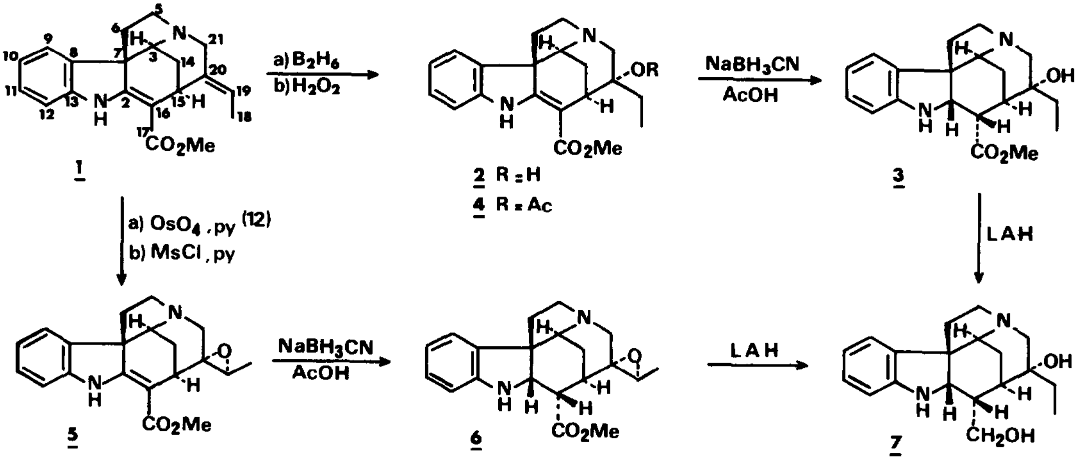
Abstract : Hydroboration-oxidation of akuammicine 1 mainly gave the tertiary alcohol 2

Hydroboration-oxidation of double bonds is a well known anti-Markovnikoff process[1,2]. In the course of applications of this method to the indole alkaloid field[3,4,5*], the following Markovnikoff hydration of a trisubstituted olefin was surprisingly observed :



Hydroboration-oxidation[6] of akuammicine 1 gave 2[7] (60%) and its 2,16-dihydroderivative 3 (10%), which was also prepared by $NaBH_3CN/AcOH$[8] reduction of 2. The 20α-hydroxy group in 2 was suspected from its dehydration (TsOH, toluene) back to 1 (10%) and from its ^1H NMR (distorded methyl triplet) and mass spectra (m/z 283, $M^{+\bullet}-C_3H_5O$). The ^{13}C NMR spectra of 2 and of its acetate 4[9,10] showed all the carbon resonances at expected values. The shielding of C-14 in 2 was ascribed to a γ-interaction with the C-20 hydroxyl group[11], while C-15, C-19 and C-21 in 4 underwent the expected upfield shifts. Upon LAH reduction, 3 gave diol 7, which was identical with the compound prepared through successive reductions of epoxide 5[12] with $NaBH_3CN$/AcOH (6) and then LAH, thus proving 2 to be 20-epi lochneridine.

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* This work was initiated by the late Professor Jean LE MEN.

Formation of the tertiary alcohol 2 as the major product may be due to the firstly formed amine borane directing hydroboration on the carbon atom closer to nitrogen ; such an effect has previously been reported[13,4] for cyclic disubstituted olefins. The electronegativity of the basic nitrogen should enhance such an effect[14].

	1	2	4		1	2	4
C-2	167,3	168,8	168,6	C-14	30,9	25,9	25,9
C-3	61,8	60,7	60,5	C-15	29,8	37,3	33,5
C-5	56,8	54,2	54,2	C-16	100,8	101,6	99,8
C-6	46,2	43,0	43,1	C-17	167,3	171,2	170,4
C-7	57,5	56,6	57,0	C-18	12,8	7,0	7,0
C-8	136,6	135,9	135,9	C-19	119,9	33,3	27,4
C-9	120,4	121,2	121,3	C-20	138,9	70,4	83,6
C-10	120,3	119,9	119,8	C-21	56,2	54,3	51,7
C-11	127,2	127,6	127,7	$COO\underline{CH}_3$	50,4	51,0	51,1
C-12	108,9	109,7	109,8	$O\underline{C}OCH_3$			172,7
C-13	143,0	144,6	144,3	$OCO\underline{CH}_3$			22,2

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6)Diborane was generated in situ from $NaBH_4$-BF_3/Et_2O.With commercial BH_3/THF solution the proportion of 3 was reduced.

7)Compound 2:mp 205-206°C;$(\alpha)_D$-706(MeOH);UV(MeOH)λmax nm(logε)236(4.02),296(3.99),328(4.15); IR(Nujol)$\bar{\nu}$cm^{-1}:3550,3350,1665,1585;MS 340(M$^{+\cdot}$),322,283,226(100%),194,167,101,99;^{1}H NMR($CDCl_3$, 60MHz):δ0.97(3H,t,J=6.5Hz),3.77(3H,s),4.50(1H),6.70-7.50(4H,m),9.06(1H,s).

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9)Compound 4:mp 166-172°C;$(\alpha)_D$-540($CHCl_3$);UV(MeOH)λmax nm 230,295,327;IR(Nujol)$\bar{\nu}$cm^{-1}: 3320, 1710,1680,1580;MS 382(M$^{+\cdot}$),322(100%),291,263,239,226,194,167,121;^{1}H NMR($CDCl_3$,60MHz): δ0.88(3H,t,J=7.5Hz),2.10(3H,s),3.76(3H,s),6.60-7.50(4H,m),9.15(1H,s).

10)Under the acetylation conditions, the epimeric lochneridine (20β-OH) suffers dehydration : Y.Nakagawa,J.M.Wilson,H.Budzikiewicz and C.Djerassi,Chem.Ind. 1986 (1962).

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