HETEROCYCLES, Vol 15, No 1, 1981

PROPELLANES. LIX. PROPELLANE CARBINOL-LACTAMS†

Iman Landheer and David Ginsburg*
Department of Chemistry, Israel Institute of Technology, Haifa, Israel

Lithium Borohydride reduced propellane imides to the respective epimeric carbinol-lactams.

We have used conjugated dienic propellanes and tetraenic propellanes of types 1 and 2 as substrates for Diels-Alder reactions in order to study the direction of attack by various dienophiles,[1] including singlet oxygen.[2] It has been shown that for many substrates of this type and suitable dienophiles, i.e. 4-substituted-1,2,4-triazoline-3,5-diones and singlet oxygen, exclusive attack occurs by 1,4-addition on the cyclohexadiene face which is syn (rather than anti) with respect to the hetero-ring. We interpreted these results in terms of a secondary orbital interaction which controls the direction of attack.[3] We then superimposed a steric factor upon this electronic one and showed that the more weighty the steric factor, the more anti-attack takes place. A simple series which could be studied for both 1 and 2 is the one in which X=O, i.e. the anhydride as compared to the corresponding lactone (2 hydrogen atoms replace both carbonyls increasing the steric factor even more).

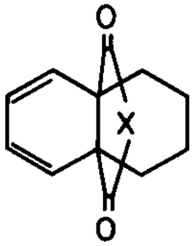
Although we have reported successful selective reduction of one of the carbonyl groups in a propellane anhydride to give the corresponding lactone[2] we have not succeeded in similarly reducing one imide carbonyl group to afford a lactam. We wish therefore to report a selective lithium borohydride reduction for an imide substrate in which only a carbonyl group is reduced, albeit only to the carbinol, rather than to the methylene stage. We have used 1, X=NMe so that we could distinguish between potentially isomeric products 3 and 4; were we to use the analog 2, for reasons of symmetry, only one such product is possible.

Although reduction stops at the carbinol-lactam stage it is clear that the approach of the reducing agent to the carbonyl group being reduced is non-selective. It does not appear to matter whether approach is from the side of the cyclohexadiene ring or of the cyclohexane ring. The

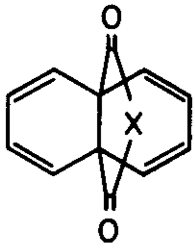
---

† Dedicated to Professor Tsetsuji Kametani on the occasion of his retirement.

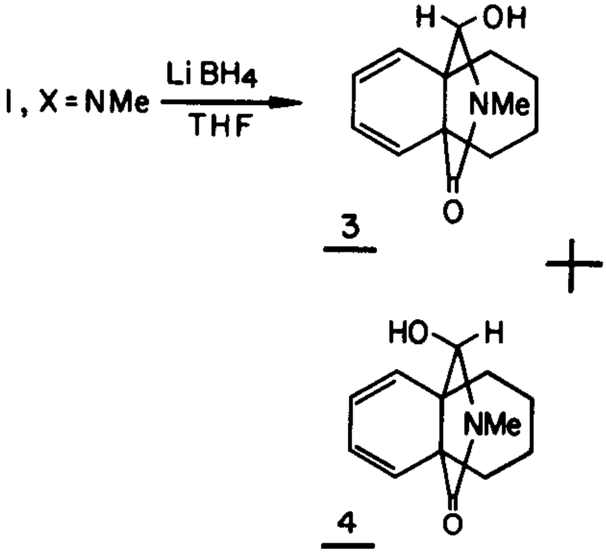
Part LVIII. M. Peled, J. Kalo and D. Ginsburg, Heterocycles, preceding paper.



1



2



ratio of 3 and 4 obtained approximates 1:1. Nor does it matter that hydrogen bonding occurs in 3 as compared to 4; this is not surprising despite the innate chemical wisdom of molecules. Indeed, perhaps it is due to this that the 1:1 ratio is obtained. The corresponding carbinols and a potential hydrogen bond are not formed until the complexes which are their precursors are hydrolyzed.

Experimental

Preparation of 3 and 4. - To a solution of $LiBH_4$ (280 mg) in dry THF (25 ml) under argon was added with magnetic stirring and ice cooling 1, X=NMe (60 mg) in dry THF (5 ml). The ice bath was removed and stirring was continued for 1 hr at r.t. HCl (6N, 3 ml) was carefully added with ice cooling and the solvent was removed at the water pump. The residue was partitioned between water (20 ml) and ether (10 ml). Aq NaOH (3N) was added until pH $\sim$ 8 and the aqueous layer extracted with ether (2 x 10 ml). The aq layer was saturated with salt and again extracted with ether (2 x 10 ml). The combined extracts were washed with conc salt solution and dried (Na_2SO_4). Filtration and evaporation gave crude product which after TLC on silica using EtOAc (1): hexane (9) gave in ascending order of polarity 1, X=NMe (12 mg), 3+4 (54 mg). These isomers were separated by TLC on silica usihg chloroform, giving in ascending order of polarity 4 (24 mg; 40%), m.p. 122-125° (ether) and 3 (24 mg; 40%), m.p. 115-117° (ether).

3: (Found: N, 6.06; M.W. 219.1239. $C_{13}H_{17}NO_2$ requires N, 6.06%; M.W. 219.1259). IR($CHCl_3$): 3620, 3505, 3345, 2900, 2825, 1686, 1394, 1060, 994 cm^{-1}. NMR($CDCl_3$): δ 6.21-5.21 (br m, 4H); 4.86 (br s, 1H, sharpens with D_2O); 4.24 (br s, 1H, no signal with D_2O); 2.82 (s, 3H); 1.53-0.84 (br m, 8H). MS: M^+, 219(30); 131(23); 105(100).

4: (Found: N, 6.34%; M.W. 219.1262). IR($CHCl_3$): 3620, 3540, 3350, 2905, 2835, 1680, 1394, 1100, 1057, 980, 960 cm^{-1}. NMR($CDCl_3$): δ 6.45-5.41 (br m, 4H); 4.26 (d, 1H, J=10 Hz, s with D_2O); 2.96 (s, 3H); 2.58 (d, 1H, J=10 Hz, no signal with D_2O); 1.94-0.86 (br m, 8H). MS: M^+, 219(30); 135(25); 133(46); 131(16); 117(14); 105(100).

References

1. M. Korat, D. Tatarsky and D. Ginsburg, Tetrahedron, 1972, **28**, 2315.
2. I.M. Landheer and D. Ginsburg, Tetrahedron, in press.
3. R. Gleiter and D. Ginsburg, Pure Appl. Chem., 1979, **51**, 1301.

Received, 9th June, 1980