Specificity of Trimethylsilanol Elimination in the Mass Spectra of the Trimethylsilyl Derivatives of Di- and Tri-hydroxy-steroids

By PAUL VOUROS* and D. J. HARVEY
(*Institute for Lipid Research, Baylor College of Medicine, Houston, Texas* 77025)

Summary The sequence of trimethylsilanol elimination in the mass spectra of trimethylsilyl steroidal ethers has been studied with the aid of ^{18}O-labelling, and found to be dependent on the structural environment of the trimethylsilyloxy-functions.

THE mass spectra of the trimethylsilyl derivatives of hydroxy-steroids contain abundant fragment ions produced by the stepwise elimination of trimethylsilanol (90 a.m.u.). No information is at present available on the specificity of this unimolecular decomposition, although there has been

interest in the sequence of trimethylsilanol elimination in a related system.[1] We have investigated, with the aid of ^{18}O-labelling, the sequence of this elimination in a number of trimethylsilyl steroidal ethers, and have found that it is not a random process, but is dependent on the structural environment of the trimethylsilyloxy-groups.

	Compound (Trimethylsilyl derivative)	Position of ^{18}O label	Distribution of trimethylsilanol elimination in the formation of $(M-90)^{+\cdot}$	Relative intensity (% base peak) $(M-90)^{+\cdot}$	Relative intensity (% base peak) $[M-(2\times90)]^{+\cdot}$
(I)	5α-Androstane-3β,17β-diol	3	13%-3β; 87%-17β	21	20
(II)	5α-Androstane-3α,17β-diol	3	46%-3α; 54%-17β	37	60
(III)	5α-Androstane-3β,16β-diol	16	7%-3β; 93%-16β	100	30
(IV)	Androst-5-ene-3β,16β-diol	16	99%-3β; 1%-16β	16	11
(V)	Androst-5-ene-3β,17β-diol	17	91%-3β; 9%-17β	50	54
(VI)	5α-Cholestane-3β,7β-diol	7	2%-3β; 98%-7β	100	13
(VII)	5α-Cholestane-3β,7α-diol	7	3%-3β;97%-7α	100	11
(VIII)	5α-Pregnane-3β,20β-diol	3	9%-3β; 91%-20β	5	2
(IX)	5α-Pregnane-3α,20β-diol	3	18%-3α; 82%-20β	5	2
(X)	Androst-5-ene-3β,16ξ,17β-triol[a]	16	14%-16ξ	66	35
(XI)	Androst-5-ene-3β,16α,17ξ-triol[a]	17	26%-17ξ	72	40
(XII)	5α-Pregnane-3β,16α,20ξ-triol[a]	20	100%-20ξ	60	3

[a] Refers to a mixture of α- and β-isomers,

Steroidal diols and triols in which one of the oxygens was specifically labelled with ^{18}O were prepared by the reduction of the corresponding mono- or di-hydroxy-ketones with lithium aluminium hydride following an exchange in 50% ^{18}O-enriched water.[2] Their trimethylsilyl derivatives were prepared according to previously described procedures.[3]

The Table shows the degree of positional specificity of the initial trimethylsilanol elimination for the various steroids studied and the relative abundances of the fragment ions produced from the stepwise losses of trimethylsilanol. The derivatives of all the saturated diols exhibit a marked tendency to eliminate trimethylsilanol from positions other than the 3-position upon electron impact. It is apparent from the spectra of (II) and (IX) that the 3α-substituent is eliminated more readily than its 3β-counterpart. The presence of a Δ^5-olefinic function resulted in preferential elimination of the 3-substituent in the spectra of the androstenediol derivatives (IV, V), but this elimination becomes less specific when an additional trimethylsilyloxy-substituent is present on the D-ring.

The observed preference for trimethylsilanol elimination from one particular site can be influenced by several factors such as the positive charge distribution in the molecular ion, the stability of the resulting $(M-90)^{+\cdot}$ ion, and the hydrogen availability. The relative importance of these or other parameters is a function of compound structure. For example, it is likely that stability of the product ion contributes most to the results seen in the spectra of (IV), (V), (X), and (XI) where the trimethylsilanol elimination may produce a system conjugated with the Δ^5-olefinic function.

Financial assistance by the National Institute of General Medical Sciences is acknowledged.

(*Received, 5th April* 1972; *Com.* 579.)

[1] R. G. Cooks and G. S. Johnson, 'Specialist Periodical Reports, Mass Spectrometry,' vol. 1, ed., D. H. Williams, The Chemical Society, London, 1971, p. 142.

[2] (a) K. Biemann, 'Mass Spectrometry,' McGraw Hill, New York, 1962, p. 237; (b) A. M. Lawson, F. A. J. M. Leemans, and J. A. McCloskey, *Steroids*, 1969, **14**, 603.

[3] E. M. Chambaz and E. C. Horning, *Analyt. Biochem.*, 1969, **30**, 7.