CORRELATION BETWEEN THE MASS-SPECTROMETRIC BEHAVIOR AND CHROMATOGRAPHIC MOBILITY OF EPIMERIC 4-ALKYL-1,2-DIMETHYL-trans-PERHYDROQUINOLOL N-OXIDES

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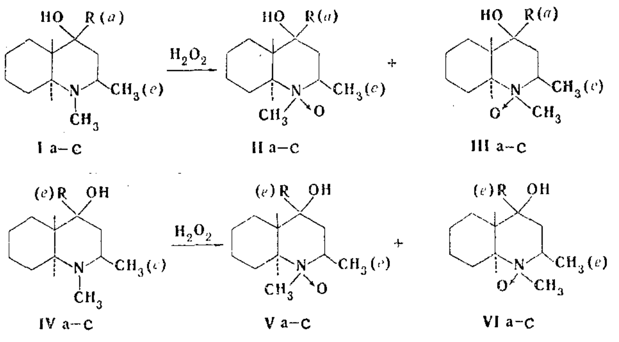
The dependence between the chromatographic mobility, the character of the disintegration under electron impact, and the configuration at $C_{(4)}$ was found for epimeric N-oxides of 1,2-dimethyl-4-ethyl-, -4-vinyl-, and -4-ethynylperhydro-4-quinolols. It is proposed that this dependence be used to determine the configuration at $C_{(4)}$ in 1,4-dialkyl-trans-perhydro-4-quinolols, from which two epimeric N-oxides can be obtained.

In [1, 2], by determination of the configuration in the 2 and 4 positions of 4-substituted 1,2-dimethyl- or 1-ethyl-2-methyl-trans-perhydro-4-quinolols, we demonstrated the fundamental possibility of the use of a mass spectrometric method for the solution of stereochemical problems in this series. The method described in [1, 2] makes it possible to determine the configuration at $C_{(4)}$ only when the mass spectra of both epimers are compared. However, we then faced the problem of establishing the configuration at $C_{(4)}$ in molecules of such substituted 2-methyl-4-alkyl-trans-perhydro-4-quinolols, which are formed during organometrallic syntheses from the corresponding ketones in the form of only one epimer. In the present paper, we discuss a possible methodical approach to the solution of this problem using the correlation between the mass spectrometric behavior and the chromatographic mobility of the N-oxides of the indicated compounds.



a $R=C{\equiv}CH$; b $R=CH{=}CH_2$; c $R=C_2H_5$

One pair of epimeric (with respect to the nitrogen atom) N-oxides (IIa-c, IIIa-c and Va-c, VIa-c, respectively) was obtained from alcohols Ia-c and IVa-c, the stereochemistry of which was established in [1], by treatment with hydrogen peroxide [3]. Except for the configuration of the N atom, the N-oxides ob-

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TABLE 1. Ratios of the Intensities of the Characteristic Peaks in the Mass Spectra of N-Oxides

Peak intensity ratio	Compound (mp, °C)											
	IIa (205)	IIIa (170)	IIb (208)	IIIb (180)	IIc (147)	IIIc (186)	Va (222)	VIa (316)	Vb (226)	VIb (140)	Vc (229)	VIc (foaming)
$I_{[M-15]^+}/I_{[M]^+}$	0,8	3,1	0,8	2,4	0,3	2,0	4,5	0,8	3,0	0,5	2,5	0,5
$I_{[M-17]^+}/I_{[M]^+}$	0,3	1,7	0,3	2,4	0,2	1,5	2,3	0,3	2,9	0,3	2,2	0,2
$I_{[M-18]^+}/I_{[M]^+}$	0,1	4,5	0,3	5,5	0,2	5,0	7,5	0,2	9,0	0,2	9,0	0,2
$I_{[M-31]^+}/I_{[M]^+}$	0,7	0,8	0,8	4,5	0,4	2,2	2,0	0,5	2,5	0,6	2,0	0,5
$I_{[M-59]^+}/I_{[M]^+}$	0,8	1,1	1,1	5,2	0,3	1,4	2,0	0,5	1,9	0,5	1,1	0,6
$I_{[M-64]^+}/I_{[M]^+}$	0,9	4,1	0,4	10,5	0,5	6,0	6,1	0,5	6,0	0,3	7,0	0,6

TABLE 2. Relationship between the Types of Mass Spectra and the R_f Values of Epimeric N-Oxides

Compound	IIa	IIIa	IIb	IIIb	IIc	IIIc	Va	VIa	Vb	VIb	Vc	VIc
Type of mass spectrum	A	B	A	B	A	B	B	A	B	A	B	A
R_f	0,56	0,35	0,66	0,41	0,66	0,47	0,68	0,46	0,63	0,51	0,60	0,44

obtained retain the stereochemistry of the starting alcohols, since the latter are regenerated on removal of the N-oxide oxygen by catalytic hydrogenation (H_2/Pd).

A mass spectrometric comparison of the epimeric N-oxides (Table 1) demonstrated that the spectra of the epimers differ markedly and, regardless of the nature of substituent R, can be grouped into two types – A and B. Both of these types are presented in Fig. 1 in the case of ethynyl alcohols. Relatively intense $[M]^{+\cdot}$ ion peaks and less intense $[M-15]^+$, $[M-17]^+$, $[M-18]^{+\cdot}$, $[M-31]^+$, $[M-59]^+$, and $[M-64]^{+\cdot}$ ion peaks are characteristic for mass spectra of the A type. However, in the mass spectra of the B type the peaks of the latter ions several times exceed the peak of the molecular ion. Of the fragment ions listed above, the first three are formed during the elimination of CH_3, OH, and H_2O, respectively, from the molecular ion, while the last three are formed during elimination of CH_3+O, C_3H_7+O, and $2CH_3+H_2O+O$. It is interesting to note that the $[M-16]^{+\cdot}$ ion peak is very small in the mass spectra of all of the examined N-oxides.

The chromatographic mobility of the N-oxides under consideration apparently depends on the conformation of the oxygen-containing substituents attached to asymmetric centers 1 and 4. It is known that alcohols of the cyclohexane series with an equatorial hydroxyl group have a lower chromatographic mobility (high affinity for the sorbent) than their axial epimers [4]. The effect of the conformation of the oxide oxygen attached to the first asymmetric center is also reflected in the R_f values of the investigated series of compounds.

An interesting regularity (Table 2) was observed on comparing the chromatographic mobility of the epimeric N-oxides [the R_f values are given for an ethanol–acetone (1:3) system and chromatography on aluminum oxide] with their mass spectral type. In the series of epimers IIa-c and IIIa-c, which contain an axial 4-alkyl group, IIa-c, which have larger R_f values, are characterized by mass spectra of the A type, while IIIa-c, which have lower R_f values, are characterized by mass spectra of the B type. However, in the series of epimers Va-c and VIa-c, which have an equatorial 4-alkyl group, N-oxides Va-c, which have higher R_f values, have mass spectra of the B type, while their epimers (VIa-c), which have lower R_f values, have spectra of the A type.

We assume that this regularity can be used for the determination of the configuration at $C_{(4)}$ in 1,4-dialkyl-trans-perhydro-4-quinolols with substituents in the rings that do not substantially affect the chromatographic mobility of the N-oxides, for example, alkyl groups. For this, a pair of epimeric N-oxides should be obtained from the corresponding alcohol, the configuration at $C_{(4)}$ in which must be determined, by the action of hydrogen peroxide. If spectra of the A and B type, respectively, are peculiar to the N-oxides with higher and lower R_f values, the starting alcohol should have the 4a-alkyl-4e-OH configuration; an inverse dependence between the relative R_f values and the types of mass spectra of the epimeric N-oxides will be evidence for the 4e-alkyl-4a-OH configuration.

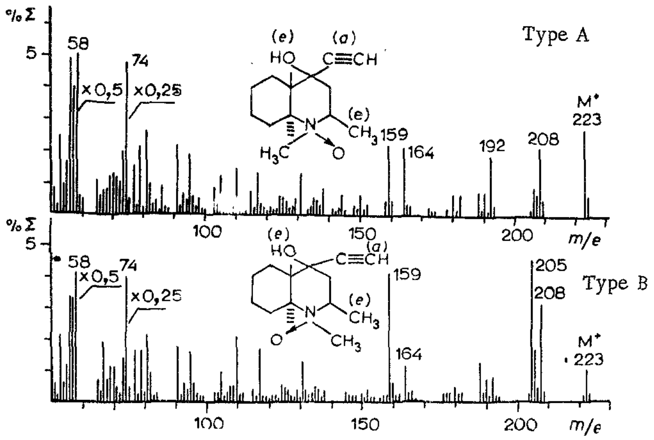

Fig. 1. Mass spectra of epimeric N-oxides IIa and IIIa.

This method cannot be used in the case of alcohols from which only one N-oxide is formed, as, for example, from alcohols with an axial 2-alkyl group. One cannot exclude the possibility that this method may also be applicable to the determination of the configuration at $C_{(4)}$ in molecules of secondary alcohols that are similar to the tertiary alcohols examined above, since their chromatographic mobilities will also be determined primarily by the 4-OH and N→O groups. The establishment of the configuration of the primary center in the N-oxides examined will be the subject of a separate communication.

EXPERIMENTAL

The mass spectra of the N-oxides were obtained with an MKh-1309 apparatus equipped with an industrial system for the direct introduction of the sample into the ion source at an ionizing electron energy of 70 eV and a sample vaporization temperature of 60-80°.

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