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# Chemical ionization mass spectrometric determination of the configuration of decahydroquinolin-4-ols

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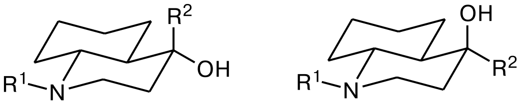
Chemical ionization mass spectrometry (isobutane or methane as a reagent gas) was proposed for the determination of the configuration of the C(4) chiral center in 1,4-disubstituted decahydroquinolin-4-ols.

**Key words:** decahydroquinolin-4-ols, mass spectrometry, stereochemistry, chemical ionization.

Chemical ionization mass spectrometry (CI MS) is an efficient method for the solution of stereochemical problems, especially in the series of di- and polyfunctional compounds.[1] In particular, sharp distinctions in easiness of dehydration of protonated molecules were found for the conformationally mobile stereoisomeric cyclic amino alcohols.[2—4]

In this work, we studied a possibility to use CI MS (isobutane and methane as a reagent gas) for the determination of the configuration of the C(4) chiral center in molecules of diastereomeric tertiary alcohols in the series of 1-alkyl-4-alkyl(ethynyl)-*trans*-decahydroquinolin-4-ols **1—5** with the conformationally rigid system.



**a** **b**

**1:** $R^1$ = Et, $R^2$ = Et; **2:** $R^1$ = $Pr^n$, $R^2$ = C≡CH; **3:** $R^1$ = $Pr^n$, $R^2$ = Et; **4:** $R^1$ = $CHMe_2$, $R^2$ = C≡CH; **5:** $R^1$ = $CHMe_2$, $R^2$ = Et

It is fairly difficult to determine the configuration of the hydroxyl-containing center in tertiary alcohols **1—5**. Chemical ionization mass spectrometry has earlier been proposed[5] for this purpose. However, this method turned out to be appropriate only for alcohols with 4-alkyl groups.

## Experimental

The structures and stereochemistry of alcohols **1—5** have been established previously.[5]

A Finnigan MAT 95XL gas chromatograph/mass spectrometer was used. Since individual stereoisomers were very volatile, they were introduced into the ion source through a gas-liquid chromatograph (the samples were prepared as solutions in chloroform). A quartz capillary column with a polymethylsiloxane phase (30 m × 0.19 mm) was used in the chromatograph (the split ratio was 1 : 30) with helium as a carrier gas. Isobutane and methane were used as a reagent gas. Experiments were carried out at the temperature of the ion source of 200 °C. Five experiments were carried out for each sample; the error of measurements of intensities of characteristic peaks was not larger than 5 rel.%.

## Results and Discussion

Chemical ionization mass spectra measured using both reagent gases contain virtually only intense peaks of the protonated molecules $[MH]^+$ and products of their dehydration $[MH - H_2O]^+$. The intensities of the peaks caused by the parallel decomposition of the $[MH]^+$ ions ($[MH - H]^{+\bullet}$, $[MH - \text{alkyl}]^{+\bullet}$) were less than 5% of the total ion current. It is known[1] that protonated molecules of carbocyclic alcohols can be totally dehydrated. Thus, the $[MH]^+$ and $[MH - H_2O]^+$ ions, whose peaks are observed in the CI spectra, correspond to the *N*- and *O*-protonated molecules, respectively, and their intensities are proportional to the content of such protonated molecules ($[M_NH]^+$ and $[M_OH]^+$) in the ion current (Table 1). It is worth mentioning that, although the proton affinity of the N atom is higher than that of the O atom, protonation occurs at any of them.

A comparison of the relative intensities of the peaks of the $[MH]^+$ and $[MH - H_2O]^+$ ions shows that the dehydration of the protonated alcohol molecules with the axial OH group is more difficult than that of their equatorial epimers, regardless of the nature of the reagent gas (isobutane or methane) and the character of the substituent at the C(4) atom (alkyl or ethynyl) (Tables 1 and 2). It can be assumed that the degree of dehydration is determined by the tendency of stereoisomers to coordinate the

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**Table 1.** Relative intensities (%) of characteristic peaks* in the CI mass spectra (isobutane) and the ratio of the *N*- and *O*-protonated molecules

| Compound | $[MH]^+$ | $[M_NH]^+/[M_OH]^+$ |
|---|---|---|
| **1a** | 49 | 33/67 |
| **1b** | 68 | 40/60 |
| **2a** | 53 | 35/65 |
| **2b** | 74 | 43/57 |
| **3a** | 50 | 33/64 |
| **3b** | 71 | 42/58 |
| **4a** | 43 | 30/70 |
| **4b** | 72 | 42/58 |
| **5a** | 49 | 33/67 |
| **5b** | 61 | 38/62 |

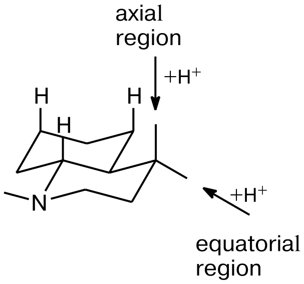
* $[MH - H_2O]^+$ 100%.

**Table 2.** Relative intensities (%) of characteristic peaks* in the CI mass spectra (methane) and the ratio of the *N*- and *O*-protonated molecules

| Compound | $[MH]^+$ | $[M_NH]^+/[M_OH]^+$ |
|---|---|---|
| **1a** | 55 | 35/65 |
| **1b** | 71 | 42/58 |
| **2a** | 52 | 34/66 |
| **2b** | 60 | 38/62 |
| **3a** | 30 | 23/77 |
| **3b** | 58 | 37/63 |
| **4a** | 45 | 31/69 |
| **4b** | 96 | 49/51 |
| **5a** | 25 | 20/80 |
| **5b** | 65 | 39/61 |

* $[MH - H_2O]^+$ 100%.

proton between the O and N atoms. However, the study of the Dreiding models for the axial and equatorial epimers with respect to the C(4) atom shows that the distances between the O and N atoms in the structures thus formed are the same (~3.4—3.6 Å) and, hence, both structures are equally probable and do not differ in the degree of dehydration. Therefore, the stereospecificity observed for protonation can be due to steric factors. In fact, it is more difficult for the bulky protonating cation to approach the 4-OH group from the axial region than from the equatorial region due to steric hindrances caused by the axial H atoms in the β-positions with respect to the OH group. Therefore, the protonation of the axial OH group should be more difficult and, hence, the fraction of the $[MH - H_2O]^+$ ion should be lower than that in the case of the equatorial OH group.



Thus, the observed regularity can be used for the determination of the configuration of the C(4) chiral center in *trans*-decahydroquinolin-4-ols using the CI mass spectra of the diastereomers. They are well separated on chromatographic columns with nonpolar liquid phases.[6] The quantitative composition of mixtures of diastereomers and the configuration of the C(4) center in each of them can be determined by gas chromatography coupled with mass spectrometry using chemical ionization (either isobutane or methane can serve as the reagent gas).

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