

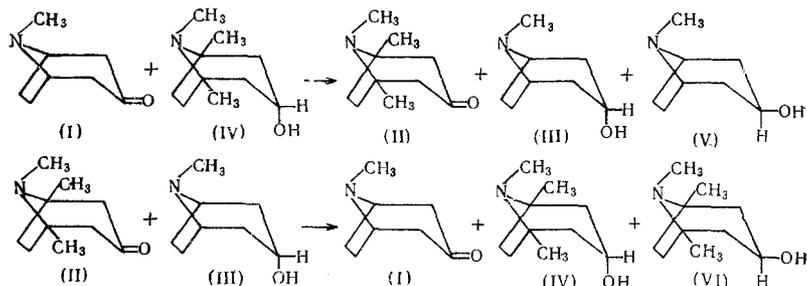
STEREOCHEMISTRY OF THE REDUCTION
OF TROPINONE, CATALYZED BY
SODIUM ALCOHOLATES

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A number of articles have been published [1-4], pertaining to the interaction of hydride ions with ketones. However, up to the present time the stereochemical course and mechanism of the oxidation and reduction catalyzed by sodium alcoholates still remain obscure [5].

In the course of our investigations, we reduced tropinone (I) with 1,5-dimethyltropine (IV) [6] and 1,5-dimethylpseudotropine (VI) [6] in a solution of sodium tert-butyrate in tert-butanol. After boiling for 30 min, the reaction was interrupted, and the reaction mixture was analyzed by thin-layer chromatography on plates with aluminum oxide. We found that the initial tropinone (I) is thereby reduced to a mixture of tropine (III) and pseudotropine (V) in a ratio of ~ 95 : 5. Under analogous conditions, 1,5-dimethylpseudotropine (VI) manifests negligible reducing ability, and only tropine (III) can be identified in the reaction mixture.



The reduction of (II) [6] with tropine (III) and pseudotropine (V) led to the same result.

The same selectivity also occurred in the dehydrogenation of isomers of tropinol with benzophenone. Thus, tropine (III), possessing an axial OH group, was converted to tropinone (I) in quantitative yield by boiling with sodium tert-butyrate in tert-butanol solution. Under analogous conditions, pseudotropine (V) remained unchanged. Partial reduction of tropinone (I) and 1,5-dimethyltropinone (II) in a solution of sodium isopropylate in isopropanol led exclusively to the formation of the axial isomers (III) and (IV). After the reaction time was lengthened, an increasing amount of the equatorial isomers (V) and (VI) was detected. Complete reduction of tropinone (I) was accomplished by boiling for 10 min in a solution of sodium pentylate in n-pentanol. Pseudotropine (V) predominates among the products of this reaction. However, when the reaction was carried out immediately after mixing of tropinone (I) with a hot solution of sodium pentylate in n-pentanol, the predominant reaction product was tropine (III).

The reduction of tropinone (I) by metallic sodium in various primary and secondary aliphatic alcohols leads to the formation of pseudotropine (V) exclusively from the very beginning of the reduction.

As a result of our experiments, we arrived at the conclusion that in catalytic reduction under the action of sodium alcoholates, the axial OH group is formed at a greater rate than the equatorial group, and that the dehydrogenation of the compound with axial OH group is considerably more rapid than that of isomers with an equatorial OH group. Actually, this reaction is sterically "kinetically controllable,"

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and the formation of a substantial amount of pseudotropine with an equatorial OH group can be explained only by the fact that there is a secondary process, leading to equilibrium, in the reduction of tropine.

It is also clear that in addition to the concentration of the sodium alcoholates and properties of the reducing alcohols [7], the oxidative potential [8] of the carbonyl compounds formed in the reduction of the alcohols is of great importance, and it may be precisely they that promote isomerization according to the scheme proposed by Doering and Aschner [8, 9].

Subsequently our work will be directed towards generalizing the results obtained and toward their application to the oxidation and reduction of steroids and other compounds.

CONCLUSIONS

1. The stereochemistry of the reduction of tropinone, catalyzed by sodium alcoholates, was studied.
2. In the catalytic reduction, the axial OH group is formed at a greater rate than the equatorial group, while dehydrogenation of compounds with axial OH group is considerably more rapid than that of isomers with an equatorial OH group.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of the first issue of this year.
