IMPROVED METHOD OF CONVERTING CARDENOLIDE ALDOXIMES INTO 10-CYANO COMPOUNDS

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We have reported the preparation of a series of 10-cyanocardenolides from 19-aldoximes by heating the latter in a mixture of acetic anhydride and pyridine [1]. A disadvantage of this method is the fact that the formation of the nitriles is accompanied by acetylation of secondary and primary OH groups in glycosides and aglycones. A better method of dehydrating oximes is known which uses dicyclohexylcarbodiimide [2]. The reaction is performed in the presence of pyridine or of triethylamine and takes about 15 h. The use of this method is restricted by the comparatively low availability of the reagent.

We have found that a simple and convenient method is heating cardenolide 19-aldoximes in dimethylformamide in the presence of anhydrous copper sulfate. The formation of 10-cyanocardenolides then takes place quantitatively in 270 min at 100°C and in 55 min at 120°C.

Analysis of the kinetic curves (Fig. 1) shows that the reaction takes place in accordance with the first-order law. The rate constants calculated from the formula

$$k = \frac{2{,}303}{t} \cdot \log \frac{C_0}{C}$$

are 0.014 and 0.074 min^{-1} for temperatures of 100 and 120°C, respectively.

The activation energy, calculated from the equation

$$E = \frac{R \ln \frac{k_2}{k_1}}{\frac{1}{T_1} - \frac{1}{T_2}},$$

is 23.6 kcal/mole.

Procedure. A mixture of 0.5 g of strophanthidine 19-aldoxime and 0.57 g of finely ground anhydrous copper sulfate was placed in a glass capsule, 1 ml of absolute dimethylformamide was added, and the capsule was sealed and was heated at 120°C for 1 h or at 100°C for 4.5 h. Then the reaction mixture was diluted with 30 ml of water and the nitrile obtained was extracted with chloroform (3 × 100 ml). The chloroform solution was washed with water (3 × 25 ml) and

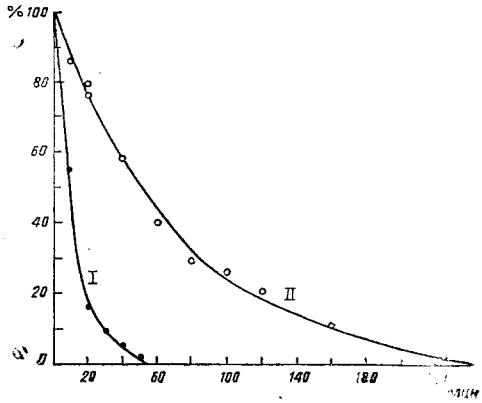

Fig. 1. Kinetic curves of the conversion of aldoximes into nitriles: I) at 120°C; II) at 100°C.

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evaporated. This gave 0.45 g of amorphous 10-cyano-3β,5,14-trihydroxy-5β,14β-card-20(22)-enolide, which was recrystallized from methanol, mp 236-240°C; $[\alpha]_{20}^{D}$ +51.1 ± 2° (c 1.0; methanol). Similarly, convallatoxin 19-aldoxime gave 10-cyanoconvallatoxin with mp 263-269°C.

The IR spectra of the 10-cyanocardenolides each have an absorption band in the 2220 cm^{-1} region that is characteristic for a CN group. The elementary analyses of the compounds obtained agreed with those calculated for the compositions $C_{23}H_{31}O_5N$ and $C_{29}H_{41}O_9N$, respectively. The kinetic measurements were carried out by a quantitative analysis of the samples using paper chromatography by a known method [3, 4].

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TRITERPENE GLYCOSIDES OF THE LEAVES OF *Fatsia japonica*. STRUCTURE OF FATSIOSIDES D, E, AND F

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We have characterized the weakly polar glycosides of fresh leaves of *Fatsia japonica* (Thunb.) Deche et Planch (family Araliaceae) [1]. One of the polar glycosides present in the air-dry leaves, fatsioside G, was identified as leontoside D [2]. Below we give information on the determination of the structures of the remaining polar glycosides — fatsiosides D, E, and F.

The glycosides were isolated by extracting the air-dry leaves with aqueous methanol followed by purification of the total material by repeated chromatography on a silica gel column in the chloroform—methanol—water (26:14:3) system.

Complete acid hydrolysis showed that fatsiosides D with mp 181-183°C, $[\alpha]_D^{20}$ +3.1° (c 1.1; MeOH), and F with mp 179-181°C, $[\alpha]_D^{20}$ +29.8° (c 2.1; MeOH) were hederagenin derivatives, and fatsioside E with mp 187-191°C, $[\alpha]_D^{20}$ +37.8° (c 3.1; MeOH) was an oleanolic acid derivative. In the carbohydrate moieties of the glycosides L-rhamnose, L-arabinose, and D-glucose were detected by PC and TLC. After reduction of the hydrolysates with sodium tetrahydroborate followed by acetylation, the acetates of rhamnitol, arabitol, and sorbitol were identified by the GLC method in a ratio of 1:1:2 for fatsioside D and a ratio of 1:1:3 for fatsiosides E and F.

Analysis of the IR spectra of the fatsiosides permitted us to assume that they contained ester bonds. As a result of the alkaline hydrolysis of the glycosides followed by acid hydrolysis of the oligosaccharide split out, and using GLC, we identified rhmanose and glucose in the form of the acetates of the corresponding polyols in a ratio of 1:2. Acid hydrolysis of the modified glycosides led to the identification of arabitol acetate for fatsioside D and of arabitol and sorbitol acetates in a ratio of 1:1 for fatsiosides E and F. After methylation by Hakomori's method [3] followed by methanolysis of the glycosides, methyl 2,3,4-tri-O-methylarabinopyranoside (1), methyl 2,3,4-tri-O-methylrhamnopyranoside (2), and methyl 2,3,6-tri-O-methylglucopyranoside (3) were identified by GLC for fatsioside D, and methyl 2,3,4,6-tetra-O-methylglucopyranoside (4) and methyl 3,4-di-O-methylarabinopyranoside (5) and also the methyl glycosides (2) and (3) for fatsiosides E and F. The results obtained were confirmed by analysis using the chromato-mass spectrometry of the acetates of the partially

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