ABSOLUTE CONFIGURATION OF ISOCEMBROL AND ITS STEREOSPECIFIC SYNTHESIS FROM CEMBRENE

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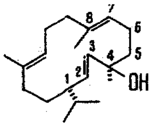
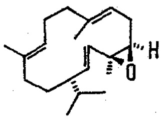
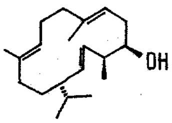
The cembrane tertiary alcohol isocembrene (thunbergol) (I) has been isolated from the oleoresin of a number of species of conifers of the family Pinaceae [1-5]. The structure and absolute configuration of isocembrol at C_1 has been shown by its conversion into cembrene and isocembrene [1, 2], while the configuration at C_4 has remained undetermined. To find it, we have used reduction of the known 4S,5R-epoxycembrene (II) [6] with lithium tetrahydroaluminate. This epoxide is obtained together with 7,8- and 11,12-epoxycembrenes when cembrene is epoxidized with peracids [6]. Since the epoxide (II) can not be separated from the isomeric epoxycembrenes without decomposition, we used for reduction the mixture of the monoepoxides mentioned obtained by the epoxidation of cembrene with an equimolar amount of peroxyacetic acid in chloroform in the presence of an excess of sodium bicarbonate. Reduction was performed with an excess of a carefully-purified solution of lithium tetrahydroaluminate in absolute tetrahydrofuran (boiling for 8 h). Under these conditions, the 7,8- and 11,12-epoxycembrenes were reduced completely to the corresponding tertiary alcohols, and epoxide (II) was reduced to isocembrol (I), identical according to TLC and IR and NMR spectroscopy with an authentic sample, and also to the secondary alcohol (III) n_D^{18} 1.5100, $[\alpha]_D^{18} + 97.5°$ (c 11.9; chloroform)). These products were formed in a ratio of 1 : 4. Because of the presence of the decomposition products of lithium tetrahydroaluminate in the reaction mixture, the epoxide (II) was partially (under the conditions used, by 10%) isomerized into the two ketones (IV) epimeric at C_4 [6, 7], which, under the reaction conditions, were reduced to a mixture of stereoisomeric alcohols. The same alcohols were obtained in model experiments on the reduction of authentic samples of the ketones (IV). The reaction mixtures were separated by column chromatography on air-dry silica gel and on silica gel containing 5% of silver nitrate.



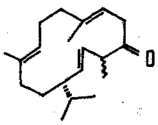
I



II



III



IV

Thus, isocembrol has the 4R configuration. The epimer of isocembrol (4-epiisocembrol) found in the oleoresins of three species of Pinus L. [5, 8] were not detected in the mixture of reduction products of the epoxycembrenes.

A characteristic feature of the optical properties of all the pairs of cembrane diterpenoids derived from 1S,2E-cembr-2-en-4-ol and epimeric at C_4 known at the present time [5, 8-12] is observed: compounds stereochemically corresponding to 4-epiisocembrol have a more positive optical rotation than their ipimers at C_4. This observation can be used to predict the absolute configuration at C_4 in similar cembrane compounds.

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TRITERPENE GLYCOSIDES OF Rhaponticum carthamoides CULTIVATED IN BELORUSSIA

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Rhaponticum carthamoides (Wilid.) Iljin (Asteraceae) has long been used in folk medicine, and a liquid extract is used in medical practice as a stimulant and adaptogenic agent [1]. Flavonoids, sterols, and ecdysones have been found in the roots of the plant [2-7]. Here we report the presence of saponins for the first time.

We studied the epigeal part of four-year plants collected in the plantation of the Central Botanical Garden of the Academy of Sciences of the Belorussian SSR in the flowering phase. The air-dry epigeal part (2 kg) was comminuted steeped in 80% ethanol for 10 days, and extracted with heating on the water bath with the same solvent for one hour three times. The combined extracts were evaporated in vacuum at 50°C, the residue was dissolved in water, and the solution was repeatedly treated with cyclohexane, chloroform, and n-butanol [8].

The butanolic extracts were concentrated. The weight of the dry residue was 64 g. This was percolated through a layer of unactivated alumina in the butan-1-ol–ethanol–water (10 : 2 : 5) system. Of the total saponins purified in this way, 15 g was transferred to a comumn (50 × 3.5 cm) containing type L 40/100 μm silica gel (Czechoslovakia) and was eluted with the chloroform–methanol–water (65 : 35 : 5) system. According to thin-layer chromatography (TLC) on type L5/40μ silica gel (Czechoslovakia) in the butanol-1-ol–ethanol–water (10 : 2 : 5) and chloroform–methanol–water (65 : 35 : 5) systems, the combined saponins isolated in this way contained eight triterpene glycosides, which were named in order of increasing polarity rhaponticosides A, B, C, D, E, F, G, and H.

The composition of the hypogeal part of the plant proved to be identical with that of the epigeal part.

The combined saponins (5 g) were placed in a tube with 5% sulfuric acid and the mixture was heated at 110°C for 8 h, after which the contents of the tube were extracted with diethyl ether. The ethereal extract was chromatographed on a column of silica gel L40/100μm with successive elution by the following solvents: benzene, benzene–diethyl ether (9 : 1, 8 : 2, 7 : 3, 6 : 4, and 5 : 5). and diethyl ether.

Benzene–diethyl ether (8 : 2) eluted an aglycone, which was then purified by TLC in the chloroform–methanol (9 : 1) system mp 331-333°C, $[\alpha]^{20}_{D} + 81°$ (c 1.1; chloroform). The aglycone was identified by its chromatographic behavior in a thin-layer of silica gel and by a mixed melting point with an authentic sample as hederagenin [9, 10].

The methyl ether of the aglycone isolated, obtained by treating an ethereal solution with diazomethane [11], and an authentic sample of the methyl ether of hederagenin proved to be identical when compared by

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