The experiments showed that the intraperitoneal administration of ℓ-chimgin in doses of 100-200 mg/kg live weight led to an increase in the antioxidant activity of the lipids, which averaged 2200 h·ml/g. In the control group (pure methyl oleate) it was 1000 h·ml/g, while for the well-known antioxidant α-tocopherol it was 1300 h·ml/g.

The results presented demonstrate that ℓ-chimgin possesses a pronounced antioxidant effect. Chimgin may apparently play the role of donor of the proton of a hydroxy group for peroxide radicals, thereby inhibiting the autooxidation of methyl oleate, because of which a break appears in the radical chain reaction.

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CYCLIZATION AND REARRANGEMENTS OF DITERPENOIDS

X. SUPERACID CYCLIZATION OF LABD-8,13E- AND -8,13Z-DIEN-15-OIC ACIDS AND THEIR ESTERS

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In continuation of studies on the superacid cyclization of terpenoids [1-4], in the present communication we report results on the cyclization of labd-8,13E- and -8,13Z-dien-15-oic acids (I and II) and their methyl esters (III and IV).

Nakano and Hernandez [5] performed the cyclization of the (±)-isomer of acid (I) having a double bond at C8—C17 with formic acid (boiling, 4 h), and, after methylation, they obtained methyl (±)-isoagath-12-en-15-oate (V) (64% yield).

By the interaction of the 13E- acid (I) in 2-nitropropane with fluorosulfonic acid (ratio of substrate to FSO_3H = 1:20, concentration of substrate 0.15 M, −(50-55)°C, 30 min; Et_3N was added to the reaction mixture and it was then worked up in the usual way), followed by the methylation of the reaction product with diazomethane and chromatographic purification on a column of SiO_2, we have isolated a 92.5% yield of methyl (14R)-isoagath-12-en-15-oate (V), mp 102-103.5°C (from CH_3OH), $[\alpha]_D^{22}$ −62° (c 1.1; $CHCl_3$). According to the literature [6], mp 104-105°C, $[\alpha]_D$ −58° (see top of following page).

Under the same conditions, the cyclization of the 13Z- acid (II) required 45 min for completion. After analogous working up, methyl (14S)-isoagath-12-en-15-oate (VI) was isolated in 86.5% yield, mp 80-81.5°C (from CH_3OH), $[\alpha]_D^{22}$ +188° (c 1.3; $CHCl_3$). Asselineau et al. [6] reported: mp 79°C, $[\alpha]_D$ +197°.

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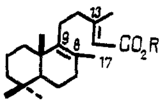
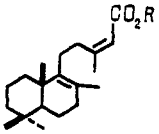
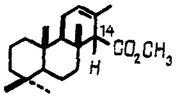


I. R = H
III. R = CH_3



II. R = H
IV. R = CH_3



V. 14αH
VI. 14βH

According to the literature [7, 8], the electrophilic cyclization of the esters (III) and (IV) under the action of 99% formic acid (room temperature, 1 h) took place fairly smoothly and led to the esters (V) and (VI), respectively, with 90% yield. Under more severe conditions (70°C, 1 h) the yield of compounds (V) and (VI) fell to 35%.

The results that we have obtained show that the use of fluorosulfonic acid as cyclizing agent permits the cyclization of the esters (III) and (IV) to be achieved under far milder conditions than with formic acid, while simultaneously increasing the efficiency of the cyclization process. Thus, ester (III) (50 mg, 0.157 mmole) reacted with fluorosulfonic acid (87 mg, 0.87 mmole) in 2-nitropropane (0.5 ml) (concentration of substrate 0.16 M, −(80-85)°C, 10 min) to give, after the usual working up, 47.6 mg (95.2%) of the ester (V). Under the same conditions but with a reaction time of 15 min, the 13Z- ester (IV) cyclized to the isoagathenoate (VI) in 91.5% yield.

Thus, the superacid cyclization of the labdane acids (I) and (II) and their esters (III) and (IV) is a highly effective, structurally selective, and stereospecific process for obtaining the isoagathane compounds (V) and (VI).

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