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STRUCTURE OF ISOLASEROLIDE FROM *LASER TRILOBUM**

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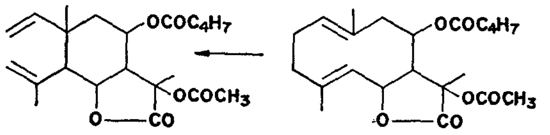
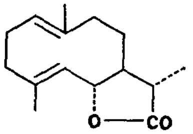
Key Word Index—*Laser trilobum*; Umbelliferae; roots; sesquiterenoid lactone; isolaserolide; structure.

Abstract—The structure I has been deduced for isolaserolide on the basis of its PMR spectrum and the chemical correlation with laserolide (II). Isolaserolide is the first elemanolide isolated from the Umbelliferae.

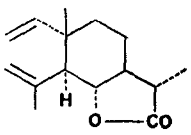
IN A preceding paper[1] we described the isolation of a compound, $C_{22}H_{30}O_6$, m.p. 125–127° and $[\alpha]_D^{25}$ −81·1°, from the roots of *Laser trilobum* (L.) Borkh. and for which we proposed the name isolaserolide. We have now investigated its structure and present evidence to show it is I. The IR spectrum of isolaserolide (I) contained absorption bands demonstrating the presence of a γ-lactone group (1785 cm^{-1}), an acetyl group (1736 and 1247 cm^{-1}), an α,β-unsaturated ester group (1712 cm^{-1}), and an exomethylene double bond (1643 and 3080 cm^{-1}). The MS of isolaserolide exhibited a molecular peak at *m/e* 390, and the peaks of fragments *m/e* 330 (390–60), 230 (390–60–100), 83 ($C_4H_7.CO^+$), and 55 ($C_4H_7^+$) (metastable: 36·4).



(I) (II)



(III)



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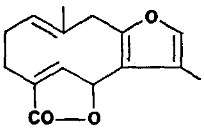

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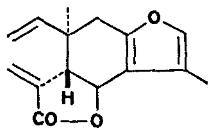

(VI)

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* Part CCXX in the series "On Terpenes". For Part CCXIX see Z. SAMEK, M. HOLUB, K. VOKÁČ, B. DROŻDŻ, G. JOMMI, P. GARIBOLDI and A. CORBELLA, *Coll. Czech. Chem. Commun.* **37** (1972) in press.

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The PMR spectrum of isolaserolide (100 MHz)* displayed characteristic signals of an *O*-acetyl group (2·01 *s*), an *O*-angelyl group (α-H: 6·17 *qq*), two tertiary *C*-methyl groups ($H_{(14)}$: 1·02 *s*; $H_{(13)}$: 1·57 *s*), an isopropenyl group $CH_3{-}C{=}CH_2$ ($H_{(15)}$: 1·80*dd*, $^4J_{15,3} = 1{\cdot}4$, $^4J_{15,3'} = 0{\cdot}6$; $H_{(3)}$: 5·05 *bdq*; $H_{(3')}$: 4·75 *bdq*, $^2J_{3,3'} \neq O \cong 0{\cdot}5$) and an isolated *C*-vinyl group $CH_2{=}CH{-}C{-}$ ($H_{(2)}$: 5·08 *dd*, $J_{2,1} = 17{\cdot}5$, $^2J_{2,2'} = 0{\cdot}7$; $H_{(2')}$: 5·02 *dd*, $J_{2',1} = 10{\cdot}6$, $^2J_{2',2} = 0{\cdot}7$; $H_{(1)}$: 5·94 *dd*, $J_{1,2} = 17{\cdot}4$, $J_{1,2'} = 10{\cdot}6$). Furthermore, from a detailed analysis based on multiple resonance experiments the presence of the following fragments was deduced $-CH(-C-)-CH-(OR)-CH(-C-)-CH(OR)-CH_2-C-$ ($H_{(5)}$: 2·15 *d*, $J_{5,6} = 12{\cdot}5$; $H_{(6)}$: 5·07 *dd*, $J_{6,5} = 12{\cdot}5$, $J_{6,7} = 10{\cdot}4$; $H_{(7)}$: 3·35 *dd*, $J_{7,6} = 10{\cdot}4$, $J_{7,8} = 8{\cdot}2$; $H_{(8)}$: 5·26 *ddd*, $J_{8,7} = 7{\cdot}7$, $J_{8,9} = 3{\cdot}5$, $J_{8,9'} = 9{\cdot}6$; $H_{(9)}$: 1·96; $H_{(9')}$: 1·47 *dd*, $J_{9',8} = 9{\cdot}5$, $^2J_{9',9} = 14$). From these facts it followed that isolaserolide is very probably a sesquiterpenic diester lactone of elemane type in which the lactone-ring is closed at $C_{(6)}$ or $C_{(8)}$ and the ester groups (acetic acid and angelic acid residues) are bound to $C_{(11)}$ and $C_{(8)}$ or $C_{(6)}$.

Since laserolide (II) was also isolated from the roots of *L. trilobum*,[1,2] it seemed reasonable to suppose that isolaserolide (I) might correspond to the product of the Cope rearrangement of this compound. Similar pairs of substances have been obtained previously; for example, dihydrocostunolide (III)[3] and sausurea lactone (IV)[3–5] from *Saussurea lappa* C. B. Clarke, and linderalactone (V)[6] and isolinderalactone (VI)[6] from the roots of *Lindera strychnifolia* Vill. Under the usual conditions of the Cope rearrangement for germacranolides (heating at 205–210°) we were indeed able to transform laserolide (II) to isolaserolide (I) in high yield. This was shown by PMR† and IR spectra and the CD of the product, which were identical with those of the isolated substance I. It follows that the conclusions regarding the structure of I drawn above from the spectral data are correct and that unambiguous localisation of the ester groups in the isolaserolide molecule can be deduced. Hence, the structure of isolaserolide may be represented by formula I. The stereostructure of isolaserolide (I) and laserolide (II) will be the object of a later communication.

Isolaserolide (I) belongs to the elemanolides which have already been found in the Compositae (for example, saussurealactone[4,5] from *Saussurea lappa* C. B. Clarke, igalane[7] from *Inula grandis* Schrenk., temisin[8] from *Artemisia maritima* L., vernodalin[9] from *Vernonia amygdalina* Del., vernolepin[10,11] and vernomenin[10,11] from *Vernonia hymenolepis* A. Rich.) and the Lauraceae (for example, isogermafurenolide[12] and hydroxyisogermafurenolide[12] from *Lindera strychnifolia* Vill. and sericealactone[13] and deoxysericealactone[13]

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* Chemical shifts are in δ (TMS)-scale; splitting in Hz (first-order analysis).

† The reaction product was analysed directly by PMR; it did not contain any detectable traces of laserolide (II) or of other possible cyclisation products. Hence, the Cope rearrangement was clearly irreversible under the conditions used. Under the mentioned conditions isolaserolide (I) remains unchanged.

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from *Neolitsea sericea* Koidz). In the Umbelliferae, this type of sesquiterpenoid lactone has not previously been found; thus, isolaserolide (I) is the first representative of elemanolides in this family. From the chemosystematic point of view, this further confirms a parallelism in the occurrence of sesquiterpenoid lactones as characteristic substances in both the Compositae and the Umbelliferae. However, it should be mentioned that lactones of the elemane type may be expected in all cases where germacranolides occur, due to the easy Cope rearrangement.

EXPERIMENTAL

M.ps were not corrected. The IR spectrum was measured on Zeiss UR-10 (Jena) spectrometer in $CHCl_3$. The CD was determined on Roussel–Jouan Dichrograph CD-185 in MeOH. The MS was measured on an AEI MS 902 spectrograph and the PMR spectrum on a Varian HA-100 apparatus in $CDCl_3$, using hexamethyldisiloxane (HMDS) as internal standard (chemical shifts are recalculated to δ (TMS)-scale using $\delta = 0{\cdot}06$ ppm for HMDS).

Isolaserolide (I) *from laserolide* (II). Laserolide (I; 20·5 mg) was heated in a sealed ampoule filled with N_2 at 205–210° (bath temp.) for 5 min. Crystallization of the product gave isolaserolide (I), m.p. 123–125°. M.m.p. (with a standard of isolaserolide) was undepressed. CD: $[\theta]_{295}$ $\pm 0°$, $[\theta]_{230}$ $-6600°$.