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ISOLAUREATIN, A CONSTITUENT FROM LAURENCIA NIPPONICA YAMADA (1)

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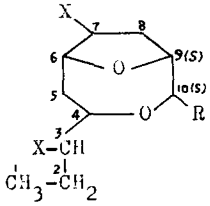
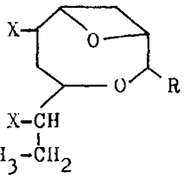
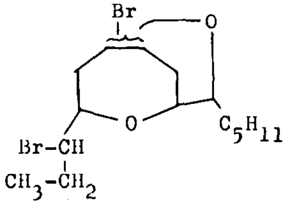
In the preceding paper (2) the isolation and structural elucidation of laureatin from *Laurencia nipponica* Yamada have been reported. From the same source, we have isolated an isomeric bromo compound, designated as isolaureatin, which is now assigned structure I on chemical and spectroscopic evidence.

Isolaureatin (I), $C_{15}H_{20}O_2Br_2$ (M^+ 394, 392 and 390), m.p. 83-84°, $[\alpha]_D$ +40° (CCl_4), shows in its UV [λ_{max}^{EtOH} 223 mμ (ε 12,400), λ_{infl} 229 (10,300)] and IR spectra [ν_{max}^{chf} 3300, 2150 (C≡CH), 1133, 1108, 1096 cm^{-1}(C-O-C)] the presence of conjugate enyne and ether functions. The NMR spectrum (3) displays absorptions of an acetylenic proton at τ 6.94 (1H, d, J = 2 c/s), two vinyl protons at τ 3.96 (1H, sex, J = 12, 7, 7) and 4.45 (1H, finely splitted d, J = 12) and methyl protons at τ 8.94 (3H, t, J = 7, 7). In addition, the signals appeared in the region of τ 6.6 to 5.7, which are ascribed to protons on carbons bearing bromine or ether oxygen atom, consist of a one-proton triplet at τ 6.51 (J = 6.5, 6.5), a one-proton double triplet at τ 6.23 and an unresolvable four-proton multiplet centered at τ ca. 5.9. The mass spectrum of I shows the fragmentation similar to that of laureatin (II) (2); *e.g.*, $M^+-C_5H_5$, $M^+-C_3H_6Br$, $M^+-C_5H_5-HBr$, etc. Thus, I is supposed to be a bicyclic ether having $-CH_2-CH=CH-C\equiv CH$ and $-CHBr-CH_2-CH_3$ groupings and to have a structure closely related to II.

I consumed three moles of hydrogen over platinum catalyst in ethanol to yield hexahydroisolaureatin (III), $C_{15}H_{26}O_2Br_2$ (M^+ 400, 398, 396); ν_{max}^{film} 1140, 1120, 1090 and 1070 cm^{-1}. The NMR spectrum of III exhibits two methyl signals at τ 9.08 (3H, br. t) and 8.93 (3H, t, J = 7, 7), a six-proton broad signal at τ ca. 8.65, eight-proton signals in the region of τ 8.5 to 7.4, a one-proton broad triplet at τ 6.69 (J = 6.5, 6.5), a one-proton multiplet centered at τ ca. 6.2 and four-proton multiplets centered at τ ca. 5.9. Treatment of III with zinc-acetic acid afforded an unsaturated glycol (IV), $C_{15}H_{28}O_2$, which was then hydrogenated to the corresponding saturated glycol (V), $C_{15}H_{32}O_2$. These glycols, IV and V, were identical with those obtained from hexahydrolaureatin (VI) (2) in all respects. On the other hand, treatment of III with Raney nickel and alkali yielded only hexahydrodebromoisolaureatin (VII), $C_{15}H_{28}O_2$, and no hydroxy ether was obtained. This result is definitely different from the case of hexahydrolaureatin (VI) (2). The NMR spectrum of VII shows only four one-proton signals in the field lower than τ 7.8 [τ 6.73 (br. t), 6.21 (br. m), 5.98 (br. t), 5.77 (br. m)]; the spectrum differs from that of hexahydrodebromolaureatin (VIII) (2) and no absorption is found in the region near τ 7.4 (4). The structure of hexahydroisolaureatin is, therefore, should be represented by either III or III'.



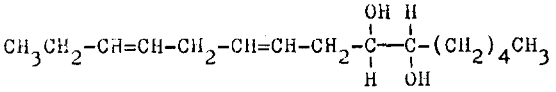




I X=Br, R= $-CH_2-CH=CH-C\equiv CH$
III X=Br, R= $-C_5H_{11}(n)$
VII X=H, R= $-C_5H_{11}(n)$

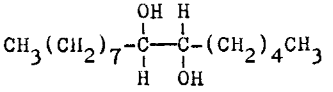
II X=Br, R= $-CH_2-CH=CH-C\equiv CH$
VI X=Br, R= $-C_5H_{11}(n)$
VIII X=H, R= $-C_5H_{11}(n)$

III'



$$CH_3CH_2-CH=CH-CH_2-CH=CH-CH_2-\underset{H}{\overset{OH}{C}}-\underset{OH}{\overset{H}{C}}-(CH_2)_4CH_3$$

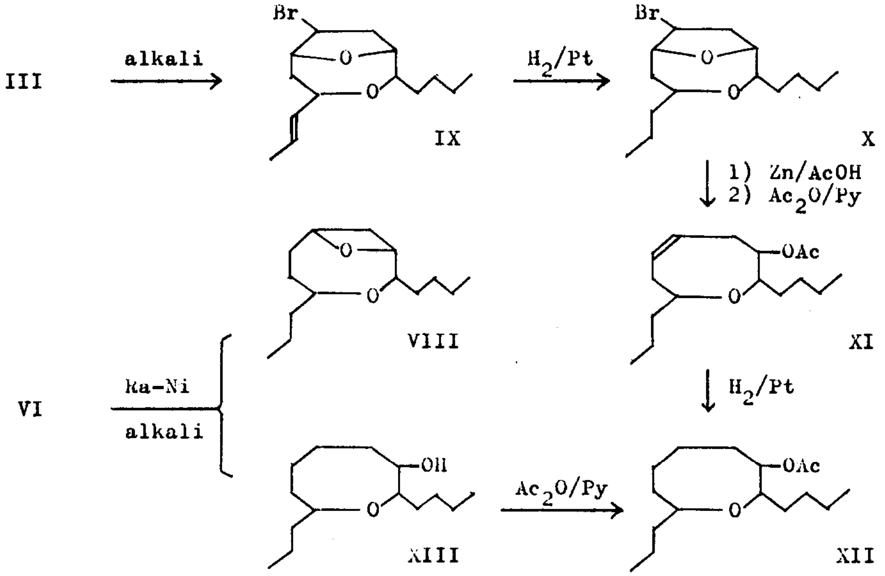
IV



$$CH_3(CH_2)_7-\underset{H}{\overset{OH}{C}}-\underset{OH}{\overset{H}{C}}-(CH_2)_4CH_3$$

V

However, the possibility of structure III' is excluded by the following evidence. Treatment with 2N ethanolic potassium hydroxide solution (4 hours reflux) effected dehydrobromination of III and yielded an unsaturated monobromo ether (IX), $C_{15}H_{25}O_2Br$ (M^+ 318, 316); τ 9.08 (3H, br. t), 8.28 (3H, d, J = 7), 6.66 (1H, m), 5.85 (4H, m) and ca. 4.4 (2H, m). On hydrogenation followed by treatment with zinc-acetic acid and then with acetic anhydride-pyridine, IX



gave an unsaturated acetoxy ether (XI), which was further hydrogenated to a saturated acetoxy ether (XII), $C_{17}H_{32}O_3$ (M^+ 284), ν_{max}^{film} 1742 cm^{-1}; τ 9.10 (3H, br. t), 9.08 (3H, br. t), 8.02 (3H, s), ca. 6.5 (2H, m) and 5.28 (1H, m). This acetoxy ether XII has been found to be identical with the specimen prepared by acetylation of the hydroxy ether (XIII) (2), obtained from VI, by comparison of their IR, NMR and mass spectra. Consequently, hexahydroisolaureatin should be represented as III and, therefore, the most probable structure of isolaureatin is I.

It is interesting to presume that laurencin (5), laureatin (II) and isolaureatin (I) would be derived (via epoxide) biogenetically from a common precursor, hexadeca-4,7,10,13-tetraenoic acid (6).

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REFERENCES

1. Part X of "Constituents from Marine Plants". Part IX, Ref. 2. This work was supported by Grant from the Ministry of Education.

2. T. Irie, M. Izawa and E. Kurosawa, Tetrahedron Letters in press.

3. NMR spectra were taken in CCl_4 with TMS as an internal standard on a Varian 100 Mc spectrometer; abbr. "d" doublet, "sex" sextet, "t" triplet, "br." broad, "m" multiplet, "s" singlet. The spectra were analyzed at first order approximation, and the more precise analysis would be required to discuss the stereochemistry, as the J-values would be accurate to ±1 c/s.

4. The signal attributable to the proton at β-position in the four membered cyclic ether in hexahydrodebromolaureatin (VIII) was found at τ 7.4.

5. T. Irie, M. Suzuki and T. Masamune, Tetrahedron Letters 1091 (1965).

6. Professor Sir Ewart Jones, private communication (cf. Chemistry in Britain 2, 6 (1966)).