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A NOVEL DIHYDROCHALCONE, LINDERATIN FROM LINDERA UMBELLATA VAR. LANCEA

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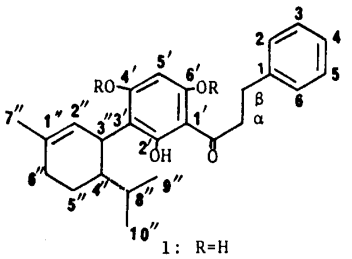
The structure of linderatin, a novel dihydrochalcone from the fresh leaves of *Lindera umbellata* Thunb. var. *lancea* Momiyama, was determined to be **1** on the basis of chemical and spectroscopic evidence.

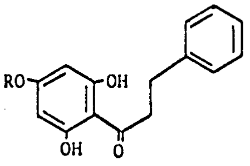
KEYWORDS—— Lauraceae; *Lindera umbellata* var. *lancea*; linderatin; dihydrochalcone; *p*-menthene

In a previous paper, we reported$^{1)}$ the isolation of two dihydrochalcones, 2',4',6'-trihydroxydihydrochalcone (**3**) and 2',6'-dihydroxy-4'-methoxydihydrochalcone (**4**), isolated from the fresh leaves of *Lindera umbellata* Thunb. var. *lancea* Momiyama. Further fractionation of *n*-hexane extract of the fresh leaves led to the isolation of a novel dihydrochalcone derivative, named linderatin (**1**). The present communication describes the structure elucidation of the compound.

Linderatin (**1**), oil, $[\alpha]_D$ +19.1° (c=0.45, $CHCl_3$), gave a bluish color with ethanolic ferric chloride. The molecular formula of **1** was determined to be $C_{25}H_{30}O_4$ by the high-resolution mass spectrum (m/z 394.2116). The ^{13}C-NMR spectrum indicated the presence of twenty-five carbons (Table I). Methylation of **1** with methyl iodide and potassium carbonate gave a dimethyl ether (**2**)$^{2),3)}$ [oil, M^+, m/z 422, ^1H-NMR (acetone-d_6) δ: 3.85, 3.93 (each 3H, 2 x s, 2 x OCH_3)]. The compound (**1**) showed the following spectra: IR $\nu_{max}^{CHCl_3}$ cm^{-1}: 3580, 3350, 1620, 1605, 1495; UV λ_{max}^{EtOH} nm (log ε): 225 (sh, 4.11), 290 (4.15). ^1H-NMR (acetone-d_6) δ: 0.82 (6H, d, J=7 Hz, 2 x CH_3), 1.64 (3H, s, CH_3), 2.92 (2H, t, J=8 Hz, C-β), 3.37 (2H, t, J=8 Hz, C-α), 3.84 (1H, br d, J=12 Hz), 5.23 (1H, s), 5.96 (1H, s, $C_{5'}$-H), 7.20 (5H, br s, 5 x arom. H), 13.88 (1H, s, OH). The ^{1}H-NMR spectrum suggested that the compound (1) is a derivative of 2',4',6'-trihydroxydihydrochalcone (3). The chemical shifts of the trihydroxydihydrochalcone moiety are as follows: δ 2.92, 3.37, 5.96, 7.20, and 13.88. This assumption was further supported by a comparative examination of the ^{13}C-NMR spectra of 1 and its dimethyl ether (2) with those of 3 and 4 (Table I). In the ^{13}C-NMR spectra of 1 and 2, the chemical shifts of the carbon atoms of the dihydrochalcone skeleton,[4] except that of the carbon atom at C-3',



1: R=H
2: R=CH_3

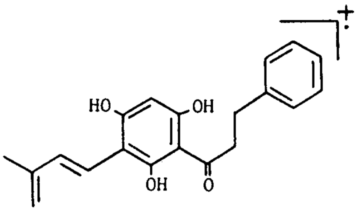


3: R=H
4: R=CH_3

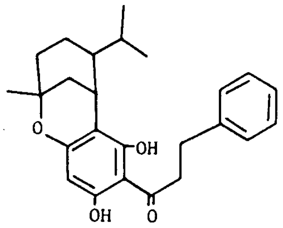
Table I. ^{13}C-NMR Chemical Shifts of 1, 2, 3 and 4 in Acetone-d_6

Carbon	1	2	3	4
C-1	143.2 s	142.6 s	142.9 s	143.3 s
C-2	129.4 d	129.1 d	129.1 d	129.6 d
C-3	129.6 d	129.2 d	129.2 d	129.8 d
C-4	127.1 d	127.0 d	126.5 d	127.1 d
C-5	129.6 d	129.2 d	129.2 d	129.8 d
C-6	129.4 d	129.1 d	129.1 d	129.6 d
C-1'	105.4 s	106.1 s	105.1 s	106.2 s
C-2'	161.4*s	162.8*s	165.4 s	165.7 s
C-3'	110.5 s	113.0 s	95.8 d	94.8 d
C-4'	163.9*s	165.4*s	165.4 s	167.4 s
C-5'	95.8 d	87.8 d	95.8 d	94.8 d
C-6'	165.9*s	165.3*s	165.4 s	165.7 s
C=O	205.9 s	205.6 s	205.2 s	206.0 s
C-α	46.6 t	46.7 t	46.3 t	46.9 t
C-β	31.5 t	31.5 t	31.4 t	30.5 t
OMe	-	56.0 q	-	56.2 q
	-	56.0 q	-	-
C-1"	135.4 s	131.9 s	-	-
C-2"	126.9 d	126.5 d	-	-
C-3"	36.0†d	36.0†d	-	-
C-4"	43.0 d	42.2 d	-	-
C-5"	23.7 t	23.9 t	-	-
C-6"	31.5 t	31.5 t	-	-
C-7"	23.7 q	23.6 q	-	-
C-8"	29.1†d	29.2†d	-	-
C-9"	16.9 q	16.7 q	-	-
C-10"	22.0 q	21.8 q	-	-

*,† Assignments may be interchanged.



(a, m/z 324.1319)



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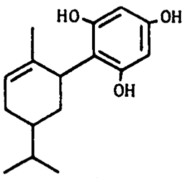

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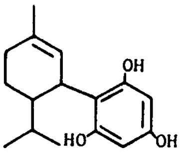

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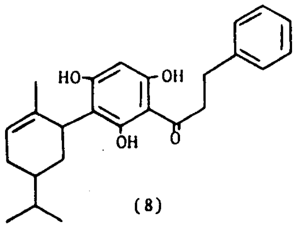

(8)

were similar to those of the relevant carbon atoms of 3 and 4. These results suggest that linderatin (1) is a 3'-substituted 2',4',6'-trihydroxydihydrochalcone derivative.

The remaining part of the C-3' substituent, consisting of the $C_{10}H_{17}$ portion in the structure of 1, was indicated by the ^{1}H-NMR spectrum to contain an isopropyl group, an olefinic proton, and a methyl group on a double bond. Comparisons of the ^{13}C-NMR spectrum of the substituent with those of the menthane type derivatives reported in the literature[5)] revealed that the chemical shifts of the carbon atoms are similar to chemical shifts of the relevant carbon atoms of p-menthene skeleton. Therefore, the deduced structure of the C-3' substituent of the $C_{10}H_{17}$ is shown to be p-menthene. Further supporting data for the structure were obtained by the following mass spectrum of 1. The mass spectrum exhibited the characteristic of fragment ion at m/z 324 (a, $M^+-C_5H_{10}$, 75.3 %), the formation of which occurred by the retro Diels-Alder reaction[6)] of p-menthene portion and this result furthermore suggested that the trihydroxydihydrochalcone moiety in 1 was linked at the C-3" carbon atom of p-menthene structure.

In order to confirm the linking position of the trihydroxydihydrochalcone moiety to the p-menthene group, we next synthesized the following two compounds (6 and 7). Condensation of phloroglucinol with a readily available p-menth-1-ene-6-ol[7)] in 5 % citric acid solution for 2 days produced the compound (6)[8)] [oil, M^+, m/z 262 , ^{1}H-NMR (acetone-d_6) δ: 0.86(3H, d, J=7 Hz, CH_3), 0.88 (3H, d, J=7 Hz, CH_3), 1.67 (3H, br s, CH_3), 3.83 (1H, br s, benzylic H), 5.76 (1H, m, olefinic H), 5.90 (2H, s, 2 x arom. H)]. On a similar treatment of phloroglucinol with piperitol,[9)] the expected compound (7) was obtained [oil, M^+, m/z 262, ^{1}H-NMR (acetone-d_6) δ: 0.83 (6H, d, J=7 Hz, 2 x CH_3), 1.69 (3H, br s, CH_3), 3.80 (1H, br d, J=10 Hz, benzylic H), 5.34 (1H, br s, olefinic H), 5.91 (2H, s, 2 x arom. H)]. The chemical shifts and coupling constants in the ^{1}H-NMR spectra of 1 and 7 were in close agreement except for those of the hydrocinnamoyl group in 1. Treatment of 1 with saturated hydrogen chloride gas in chloroform afforded the compound (5),[3)] whose spectral data showed the presence of a benzopyran structure[10)] and a tert-methyl group [mp 128-130°C, M^+, m/z 394; ^{1}H-NMR ($CDCl_3$) δ: 0.94 (3H, d, J=7 Hz, CH_3), 1.05 (3H, d, J=7 Hz, CH_3), 1.33 (3H, s, CH_3), 3.00 (2H, t, J=8 Hz, C-β), 3.40 (2H, t, J=8 Hz, C-α), 5.83 (1H, s, $C_{3'}$-H), 7.18 (5H, br s, 5 x arom. H)]. These data suggest that the double bond in the p-menthene portion located at C-1" and linderatin 1 contains the partial structure (7) in the molecule. Thus, the alternative structure (8) was eliminated and linderatin was represented by the formula (1).

As to the stereochemistry of the p-menthene portion, we examined the ^{1}H-NMR spectrum of 1. Namely, the olefinic proton ascribed to C-2" position was observed as a singlet at δ 5.23 and the coupling constant between the $C_{3''}$-H and $C_{4''}$-H was 12 Hz, demonstrating that the hydrogens are trans-oriented. The relative stereostructure of (1) was thus deduced for linderatin.

This is the second example$^{11)}$ of a new class of compound in which a C_6-C_3-C_6 unit (flavonoid) is linked with a cyclic monoterpene.

REFERENCES AND NOTES

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2) All new compounds gave satisfactory elemental analyses, and their structures were supported by spectral data. ^{1}H-NMR spectra were measured at 100 MHz.

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7) This compound was prepared by hydrogenation of carvone in the presence of tris(triphenylphosphine)chlororhodium(I) and hydrogen atmosphere, followed by reduction with sodium borohydride.

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