Journal of Natural Products
Vol. 51, No. 5, pp. 915-917, Sep-Oct 1988

TWO NEW DIHYDROCHALCONES FROM *LINDERA ERYTHROCARPA*

KAZUHIKO ICHINO, HITOSHI TANAKA, KAZUO ITO,*

Faculty of Pharmacy, Meijo University, Tenpaku-ku, Nagoya 468, Japan

TOSHIHIRO TANAKA, and MIZUO MIZUNO

Gifu Pharmaceutical University, 6-1 Mitahora-higashi 5-chome, Gifu 502, Japan

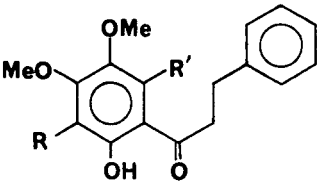
ABSTRACT.—Two new dihydrochalcones, dihydropashanone [**1**] and dihydrokanakugiol [**2**], were isolated from *Lindera erythrocarpa*. Their structures were elucidated by chemical and spectroscopic means.

The small deciduous tree, *Lindera erythrocarpa* (Lauraceae) Makino (Japanese name, "Kanakugi-no-ki"), is widely distributed in Japan, and its dried fruits are used as a folk medicine (digestive and anodyne drugs) (1). From the dried fruits of this plant, Liu *et al.* (2) isolated four pent-4-ene-1,3-dione derivatives, linderone, methyllinderone, lucidone, and methyllucidone, and later, Liu and Ogihara (1) isolated two flavonoids, kanakugiol and kanakugin.

We have reinvestigated the leaves, wood, and roots of *L. erythrocarpa*, and seven compounds were isolated. Five of the compounds were identified as 5,6-dehydrokawain (3), pinostrobin (3), methyl cinnamate, helilandin B (4,5), and pashanone (5,6) by direct comparison with the authentic samples. In this paper, we wish to describe the isolation and the structure elucidation of the remaining two compounds **1** and **2**.

Compound **1**, colorless prisms, mp 130–132°, gave a brown color with ethanolic $FeCl_3$, and the molecular formula was established by hrms (*m/z* 302.1160; $C_{17}H_{18}O_5$). The ir spectrum (3475 and 1635 cm^{-1}) indicated the presence of at least one phenolic hydroxyl group and a conjugated ketone group. The ^{1}H-nmr spectrum displayed an ethylene group at δ 3.03 and 3.42, two methoxyl groups at δ 3.83 and 3.88, an aromatic proton at δ 6.06 (1H, s), a hydroxyl group at δ 6.78, a phenyl group at δ 7.19–7.31, and a chelated hydroxyl group at δ 13.42. These data suggested that this compound is a 2′-hydroxydihydrochalcone with two methoxyl groups and two hydroxyl groups on the A ring, and it was suspected to be a dihydro derivative of one of the chalcones known in this plant. As pashanone was the only isomer isolated from this plant having two methoxyl groups and two hydroxyl groups on the A ring, we thought the compound may be a dihydro derivative of pashanone. Catalytic hydrogenation of pashanone gave 2′,6′-dihydroxy-4′,5′-dimethoxydihydrochalcone [**1**], which was indistinguishable from the natural product in all respects. This compound is known as dihydropashanone (7), but this is the first time it has been reported from a natural source.

Compound **2**, a viscous oil, gave a brown color with ethanolic $FeCl_3$, and the molecular formula was established by hrms (*m/z* 346.1418; $C_{19}H_{22}O_6$). The ir spectrum (1620 cm^{-1}) indicated the presence of a conjugated ketone group. The ^{1}H-nmr spectrum displayed an ethylene group at δ 3.03 and 3.38, four methoxyl groups at δ



1 R=H, R′=OH
2 R=R′=OMe

3.79, 3.86, 3.91, and 4.08, a phenyl group at δ 7.18–7.33, and a chelated hydroxyl group at δ 13.03. These data suggested that this compound is a 2′-hydroxy-3′,4′,5′,6′-tetramethoxydihydrochalcone. Kanakugiol was hydrogenated over Pd-C to afford the dihydrochalcone, and we named this new compound dihydrokanakugiol [**2**].

EXPERIMENTAL

GENERAL EXPERIMENTAL PROCEDURES.—All mps are uncorrected. Cc was run on Merck Si gel 60 (70–230 mesh) and florisil (100–200 mesh). Tlc was performed on glass plates precoated with Kieselgel 60 F_{254} (Merck). Ms were recorded on a Hitachi M-52 spectrometer and hrms on a Hitachi M-80 spectrometer. Ir spectra were obtained on a JASCO IR-810 spectrophotometer and uv spectra on a JASCO UVIDEC-410 double-beam spectrophotometer. ^{1}H-nmr spectra were recorded on a JEOL JNM-GX-270 spectrometer operating at 270 MHz and ^{13}C-nmr spectra on a JEOL JNM-FX-100 Fourier transform spectrometer at 25 MHz, with TMS as an internal standard. Chemical shifts are quoted in ppm.

EXTRACTION AND ISOLATION.—*L. erythrocarpa* was collected at Motosu-gun, Gifu prefecture, Japan (where a voucher specimen is deposited at the University), in July 1987. The plant material was divided into three parts, leaves (3.9 kg), wood (13.3 kg), and roots (6.8 kg), and then extracted with MeOH.

The MeOH extract of leaves was divided into hexane- and $CHCl_3$-soluble fractions. The former fraction (30.0 g) was chromatographed on a column of florisil. Elution with C_6H_6 gave dihydropashanone (35 mg), methyl cinnamate (12 mg), helilandin B (10 mg), and dihydrokanakugiol [**2**] (24 mg). Elution with C_6H_6-EtOAc (10:1) gave kanakugiol (367 mg), methyllinderone (144 mg), methyllucidone (318 mg), and kanakugin (25 mg). The latter fraction (30.0 g) was chromatographed on a column of florisil. Elution with C_6H_6 gave methyllucidone (878 mg), dihydropashanone [**1**] (75 mg), pashanone (11 mg), and pinostrobin (50 mg).

The MeOH extract of wood was divided into hexane- and $CHCl_3$-soluble fractions. The former fraction (41.2 g) was chromatographed on a column of florisil. Elution with C_6H_6 gave kanakugiol (1.632 g), methyllinderone (513 mg), methyllucidone (61 mg), and kanakugin (14 mg). The latter fraction (36.4 g) was chromatographed on a column of SiO_2. Elution with $CHCl_3$ gave kanakugiol (504 mg), methyllinderone (134 mg), methyllucidone (61 mg), kanakugin (135 mg), dihydrophashanone [**1**] (5 mg), and pashanone (20 mg).

The MeOH extract of roots was added to hexane, and the resulting precipitate was collected by filtration. The solid was recrystallized from MeOH to give pinostrobin (744 mg), and the hexane solution was concentrated to give a viscous oil (15.2 g). The residual MeOH solution was extracted with $CHCl_3$, and the $CHCl_3$ extract was concentrated to give a viscous oil (23.0 g). The hexane-soluble fraction was chromatographed on a column of florisil. Elution with C_6H_6 gave pinostrobin (1.698 g). Elution with C_6H_6-EtOAc (10:1) gave kanakugiol (279 mg), methyllinderone (5 mg), pinostrobin (3.194 g), and 5,6-dehydrokawain (462 mg). The $CHCl_3$-soluble fraction was chromatographed on a column of SiO_2. Elution with $CHCl_3$ gave kanakugiol (48 mg), methyllinderone (67 mg), kanakugin (44 mg), pinostrobin (375 mg), and 5,6-dehydrokawain (3.154 g).

The identification of helilandin B and pashanone was made by direct comparison with synthetic samples (5), and methyllinderone, methyllucidone, kanakugiol, and kanakugin were identified by comparison of the spectral data and physical data with those published in the literature (1,8).

DIHYDROPASHANONE [**1**].—Colorless prisms; mp 130–132° (from $CHCl_3$); eims *m/z* [M]$^+$ 302, 287, 197, 105; hrms *m/z* 302.1160 (calcd for $C_{17}H_{18}O_5$, 302.1153); ir ν max ($CHCl_3$) 3475, 3020, 1635, 1600, 1510 cm^{-1}; uv λ max (EtOH) 212, 233 (sh), 284, 341 nm; uv λ max (EtOH + 5% NaOH) 210, 246 (sh), 294, 375 nm; ^{1}H nmr ($CDCl_3$) δ 3.03 (2H, t, J = 7.7 Hz, β-H), 3.42 (2H, t, J = 7.7 Hz, α-H), 3.83, 3.88 (6H, s × 2, 2 × OMe), 6.06 (1H, s, 3′-H), 6.78 (1H, s, 6′-OH), 7.19–7.31 (5H, m, Ar-H), 13.42 (1H, s, 2′-OH); ^{13}C nmr ($CDCl_3$) δ 204.5 (C=O), 162.0 (C-4′*), 158.1 (C-6′*), 151.3 (C-2′*), 143.5 (C-1$^+$), 141.6 (C-3′$^+$), 128.5 (C-2,3,5, and 6), 126.0 (C-4), 103.8 (C-1′), 92.7 (C-5′), 61.4 (OMe), 56.0 (OMe), 45.3 (C-α), 30.5 (C-β). (Values with an * or a $^+$ are interchangeable.)

DIHYDROKANAKUGIOL [**2**].—Viscous oil; eims *m/z* [M]$^+$ 346, 331, 241; hrms *m/z* 346.1418 (calcd for $C_{19}H_{22}O_6$, 346.1415); ir ν max ($CHCl_3$) 3020, 1620, 1605 cm^{-1}; uv λ max (EtOH) 214, 282, 347 nm; ^{1}H nmr ($CDCl_3$) δ 3.03 (2H, t, J = 7.4 Hz, β-H), 3.38 (2H, t, J = 7.4 Hz, α-H), 3.79, 3.86, 3.91, 4.08 (12H, s × 4, 4 × OMe), 7.18–7.33 (5H, m, Ar-H), 13.03 (1H, s, OH); ^{13}C nmr ($CDCl_3$) δ 205.6 (C=O), 154.4 (C-4′*), 153.6 (C-6′*), 151.2 (C-2′*), 141.4 (C-1), 138.1 (C-5′$^+$), 136.9 (C-3′$^+$), 128.5 (C-2,3,5, and 6), 126.0 (C-4), 110.4 (C-1′), 61.3 (2 × OMe), 61.0 (2 × OMe), 45.2 (C-α), 30.4 (C-β). (Values with an * or a $^+$ are interchangeable.)

CATALYTIC REDUCTION OF PASHANONE.—A suspension of pashanone (3 mg) and 10% Pd-C (3 mg) in iPrOH (1 ml) was stirred under an H_2 atmosphere until uptake had ceased. The reaction mixture was filtered off and evaporated to dryness to give colorless prisms (3 mg). All the spectral data of this compound were indistinguishable from those of dihydropashanone [**1**].

CATALYTIC REDUCTION OF KANAKUGIOL.—A suspension of kanakugiol (22 mg) and 10% Pd-C (11 mg) in MeOH (3 ml) was stirred under an H_2 atmosphere until uptake had ceased. The reaction mixture was filtered off and evaporated to dryness to give a colorless oil (11 mg). All the spectral data of this compound were indistinguishable from those of dihydrokanakugiol [**2**].

LITERATURE CITED

1. S.-Y. Liu and Y. Ogihara, *Yakugaku Zasshi,* **95**, 1114 (1975).
2. S.-Y. Liu, H. Hisada, and I. Inagaki, *Phytochemistry,* **12**, 233 (1973).
3. K. Ichino, H. Tanaka, and K. Ito, *Tetrahedron,* **44**, 3251 (1988).
4. J.S. Rathore, S.K. Garg, A. Nagar, N.D. Sharma, and S.R. Gupta, *Planta Med.,* **43**, 86 (1981).
5. K. Ichino, H. Tanaka, K. Ito, T. Tanaka, and M. Mizuno, *J. Nat. Prod.,* submitted.
6. S.C. Agarwal, A. Bhaskar, and T.R. Seshadri, *Indian J. Chem.,* **11**, 9 (1973).
7. A. Bhaskar and T.R. Seshadri, *Indian J. Chem.,* **12**, 557 (1974).
8. H.H. Lee, *Tetrahedron Lett.,* 4243 (1968).

Received 1 March 1988