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KIAUTSCHOVIN, A NOVEL SESQUITERPENOID FROM *EUONYMUS KIAUTSCHOVICUS*

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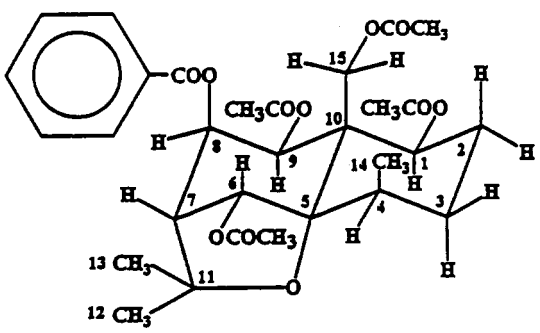
ABSTRACT.—Kiautschovin [**1**], a novel sesquiterpenoid based on the dihydro-β-agarofuran skeleton, has been isolated together with eight known compounds of the same type from the fruits of *Euonymus kiautschovicus*. The chemical structure of **1** was elucidated on the basis of spectral analysis, including 2D nmr spectroscopy.

Euonymus kiautschovicus Loes. (syn. *E. patens* Rehd.) (Celastraceae) is a little-known plant species indigenous to eastern and central China. From a chemical point of view, it has not been investigated previously. As part of our research into biologically active secondary metabolites from Celastraceae species, the sesquiterpene constituents of *E. kiautschovicus* were studied. From the petroleum ether-soluble extract of the fruits a new sesquiterpene ester, kiautschovin [**1**] and eight known compounds [**2–9**] were isolated, and all belong to the dihydro-β-agarofuran series.

Kiautschovin [**1**] was obtained as a viscous oil. Its molecular formula $C_{30}H_{38}O_{11}$ was determined by hrfabms and nmr analysis. Compound **1** exhibited ir absorption bands at 1725, 1710, 1610, 1450, and 700 cm^{-1} and uv maxima at 233, 270 sh, 276, and 283 nm, characteristic of ester and phenyl groups. Analysis of the ^1H- and ^{13}C-nmr data of **1** revealed the presence of four acetate [^1H nmr: δ 1.91, 1.97, 1.99, 2.13, 4×3H-singlets; ^{13}C nmr: δ 169.22, 2×169.72, 170.84, 4×-COO-, and δ 20.71, 21.00, 2×21.29, 4×Me] and one benzoate (^1H nmr: δ 7.47–8.15, 5H; ^{13}C nmr: δ 166.27, -COO-, and δ 130.20, 2×128.47, 2×129.91, 133.28, $-C_6H_5$) ester groups. The ^{13}C- and DEPT nmr spectra suggested that the remaining parent skeleton consisted of fifteen carbons: three methyls, six methines, three methylenes, and three quaternary carbons (see Table 1). The ^{13}C-nmr chemical shift values indicated a pentasubstituted dihydro-β-agarofuran skeleton (1). The ^1H-nmr spectrum of **1** contained signals in the region δ 4.49–6.80 ppm, which indicated esterification at C-1, C-6, C-8, C-9, and C-15 (2).

The relative configuration of **1** was elucidated via a NOESY nmr experi-



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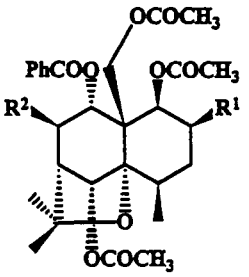
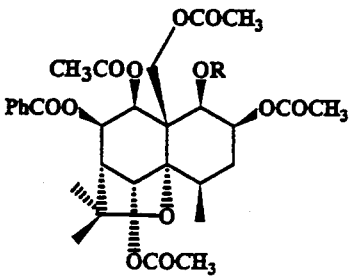


	R^1	R^2
2	H	H
3	$OCOCH_3$	H
4	OCOPh	H
5	H	$OCOCH_3$
6	$OCOCH_3$	$OCOCH_3$
7	$OCOCH_3$	OCOPh



	R
8	$COCH_3$
9	COPh

ment. The methyl proton signal at δ 1.55 ppm (H-13) correlated with the proton signals at δ 5.65 ppm (H-8) and δ 5.52 ppm (H-9). Proton H-8 therefore has equatorial, while proton H-9 has axial stereochemistry. The cross-peaks between H-9 and H-1, H-15 and H-6, and H-15 and H-14 confirmed the axial orientation of H-1, H-6 and the 14-methyl group. The ester group distribution was determined on the basis of the NOESY spectrum. Thus, observation of the cross-peak between H-12 and one acetyl methyl signal (δ 2.13 ppm) indicated an acetate group at C-6, while the correlation between the ortho-benzoyl protons and H-6 suggested the location of an aromatic ester on C-8. The positions of the ester groups were unambiguously established by means of a COLOC nmr experiment. The long-range couplings of the carbonyl carbon signals at δ 169.72, 169.72, 169.22, and 170.84 ppm with the proton signals at δ 5.37 (H-1), 6.80 (H-6), 5.52 (H-9), 4.62, and 4.49 (H-15) ppm and the acetyl methyl signals at δ

TABLE 1. ^{1}H- (400 MHz) and ^{13}C- (100 MHz) Nmr Spectral Data of Kiautschovin [**1**].[a]

Atom	δ_H (J=Hz)	δ_C	Atom	δ_H (J=Hz)	δ_C
1	5.37 dd (11.8, 4.8)	79.63	*Benzoyl*		
2	1.80 m	22.98	1′	—	130.20
	1.71 m		2′,6′	8.15 d (7.2)	129.91
3	2.22 m	26.26	3′,5′	7.59 t (7.5)	128.47
	1.46 m		4′	7.47 t (7.5)	133.28
4	2.25 m	33.27	C=O	—	166.27
5	—	90.58	*1-OAc*		
6	6.80 s	74.86	Me	1.91 s	21.00
7	2.53 d (4.0)	53.46	C=O	—	169.72
8	5.65 dd (5.7, 4.1)	70.97	*6-OAc*		
9	5.52 d (5.6)	72.13	Me	2.13 s	21.29
10	—	50.26	C=O	—	169.72
11	—	80.85	*9-OAc*		
12	1.43 s	30.35	Me	1.97 s	20.71
13	1.55 s	24.64	C=O	—	169.22
14	0.95 d (7.5)	14.97	*15-OAc*		
15	4.49, 4.62	60.97	Me	1.99 s	21.29
	AB q (13.2)		C=O	—	170.84

[a]$CDCl_3$ as solvent, TMS as internal standard.

1.91, 2.13, 1.97, and 1.99 ppm showed the presence of acetyl groups on C-1, C-6, C-9, and C-15, respectively. The carbonyl carbon signal at δ 166.27 ppm was correlated with the proton signals at δ 8.15 ppm (benzoyl ortho protons) and δ 5.65 ppm (H-8); this confirmed the benzoyloxy group on C-8. The COLOC spectrum of **1** revealed the connectivities of C-5 to H-14, H-7, and H-15, C-10 to H-8 and H-9, and C-11 to H-12, H-13, and H-6, which established the chemical shift assignments of the quaternary carbons.

With regard to all of the above data, the structure of kiautschovin was formulated as **1**. The complete assignments of all ^{1}H- and ^{13}C-nmr signals were determined from the HETCOR and ^{1}H-^{1}H COSY nmr spectra (Table 1). Kiautschovin [**1**] is the first ester derivative of 1β,6α,8β,9β,15-pentahydroxydihydro-β-agarofuran whose structure has been completely elucidated.

Eight known dihydro-β-agarofurans [**2–9**] were also isolated from the fruit of *E. kiautschovicus*, and identified on the basis of their ^{1}H-nmr data. All compounds were previously reported as metabolites of the *Euonymus* genus (2–4). The insect antifeedant activity of compounds **3** and **6** against *Spodoptera littoralis* was recently reported (5). Considering the previously documented insecticidal, cytotoxic, and anti-tumor-promoting activities of dihydro-β-agarofuran derivatives (6–8), the isolated compounds **1–9** seem worthy of biological studies.

EXPERIMENTAL

GENERAL EXPERIMENTAL PROCEDURES.—^{1}H-nmr, ^{13}C-nmr, DEPT, and 2D nmr spectra were recorded on a Bruker AM-400 nmr spectrometer with $CDCl_3$ as solvent and TMS as internal standard. Uv spectra in MeOH were obtained on a Specord UV-VIS spectrophotometer. Ir spectra were determined on a Specord 75 instrument (KBr). Mass spectral measurements were carried out on a VG ZAB2-SEQ tandem mass spectrometer operating at 30 kV in a NOBA matrix in the positive-ion mode. Cc was performed over a polyamide (Macherey-Nagel, 0.05–0.16 mm) column. For prep. tlc, Si gel 60 F_{254} (Merck) plates and the following developing systems were used: (a) cyclohexane-CH_2Cl_2-EtOH (40:60:1), (b) C_6H_6-EtOAc (4:1), (c) cyclohexane-EtOAc-EtOH (120:30:1). Hplc was carried out on a normal-phase column (BST SI-100-S; 5 μm, 200×7 mm), with cyclohexane-EtOAc-EtOH (60:30:1) as eluent.

PLANT MATERIAL.—The fruits of *E. kiautschovicus* were collected in September 1991 from the Nursery-Garden of the Town Planning Council, Veszprém, Hungary, and identified by Prof. Dr. Gábor Schmidt (University for Horticulture and Food Industry, Budapest, Hungary). A voucher specimen is deposited at the Department of Pharmacognosy, Albert Szent-Györgyi Medical University, Szeged, Hungary.

EXTRACTION AND ISOLATION.—The fresh fruits (147 g) of *E. kiautschovicus* were extracted with MeOH at room temperature. The crude extract was concentrated *in vacuo* and partitioned between petroleum ether and H_2O. On evaporation, the organic phase gave a residue (3.0 g), which was chromatographed over a polyamide column with mixtures of MeOH/H_2O as eluents. The fractions obtained with MeOH-H_2O (1:1) were further purified by prep. tlc using solvent systems (a) and (b), and hplc to yield compounds **1** (26 mg), **2** (66 mg), **3** (59 mg), **5** (5 mg), **6** (8 mg), **8** (16 mg), and **9** (13 mg). From fractions eluted with MeOH-H_2O (3:2) after repeated prep. tlc [solvent systems (a) and (c)] compounds **4** (7 mg) and **7** (2 mg) were isolated.

Kiautschovin [**1**].—The compound was obtained as a viscous oil: $[\alpha]^{25}D$ −50.7° (*c*=0.34, $CHCl_3$); uv λ max 233 (ε 14000), 270 sh (ε 2300), 276 (ε 2400), 283 (ε 2200) nm; ir ν max 2900, 2830, 1725, 1710, 1610, 1450, 1440, 1360, 1290, 1270, 1220, 1090, 1080, 1020, 700 cm^{-1}; fabms *m/z* 575 $[M+H]^+$, 533 $[(M+H)-CH_2CO]^+$, 515 $[(M+H)-CH_3COOH]^+$, 453 $[(M+H)-PhCOOH]^+$, 393 $[(M+H)-PhCOOH-CH_3COOH]^+$, 333 $[(M+H)-PhCOOH-2\times CH_3COOH]^+$, 273 $[(M+H)-PhCOOH-3\times CH_3COOH]^+$, 105 $[PhCO]^+$; hrms *m/z* 575.2497 (calcd for $C_{30}H_{39}O_{11}$, 575.2492) $[M+H]^+$; ^{1}H and ^{13}C nmr, see Table 1.

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CORRIGENDA

For the paper by Zhang *et al.* entitled "A Novel Diterpenolide from the Soft Coral *Sarcophyton solidun*," *J. Nat. Prod.,* **55**, 1672 (1992), the authors request that the name of the organism be changed throughout the paper to *Sarcophyton solidum*. The authors apologize for any inconvenience caused.

For the paper by Cabral *et al.* entitled "A New Antimalarial Quassinoid from *Simaba guianensis*," *J. Nat Prod.,* **56**, 1954 (1993), the departmental affiliation of the senior author, James D. McChesney, was not included. His correct address should read, "Department of Pharmacognosy and the Research Institute of Pharmaceutical Sciences, School of Pharmacy, University of Mississippi, University, MS 38677."