

## **Oligo-Nicotinated Sesquiterpene Polyesters from *Maytenus ilicifolia***

Hideji Itokawa, Osamu Shirota, Kenichiro  
Ichitsuka, Hiroshi Morita, and Koichi Takeya

*J. Nat. Prod.*, **1993**, 56 (9), 1479-1485 • DOI:  
10.1021/np50099a006 • Publication Date (Web): 01 July 2004

Downloaded from <http://pubs.acs.org> on April 4, 2009

### **More About This Article**

---

The permalink <http://dx.doi.org/10.1021/np50099a006> provides access to:

- Links to articles and content related to this article
- Copyright permission to reproduce figures and/or text from this article



**ACS Publications**  
High quality. High impact.

Journal of Natural Products is published by the American  
Chemical Society, 1155 Sixteenth Street N.W., Washington,  
DC 20036

## OLIGO-NICOTINATED SESQUITERPENE POLYESTERS FROM *MAYTENUS ILICIFOLIA*

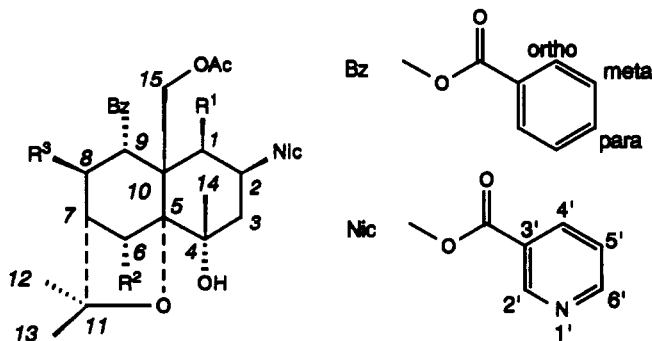
HIDEJI ITOKAWA,\* OSAMU SHIROTA, KENICHIRO ICHITSUKA,  
HIROSHI MORITA, and KOICHI TAKEYA

Department of Pharmacognosy, Tokyo College of Pharmacy, 1432-1 Horinouchi,  
Hachioji, Tokyo 192-03, Japan

**ABSTRACT.**—Five novel oligo-nicotinated sesquiterpene polyesters based on a dihydroagarofuran core, cangorins A [1], B [2], C [3], D [4], and E [5], have been isolated from *Maytenus ilicifolia*. <sup>1</sup>H- and <sup>13</sup>C-nmr spectroscopic studies, mainly 2D experiments including heteronuclear correlation, long range correlation, and nOe spectra, and mass spectral data revealed their structures containing some nicotiny, benzoyl, and acetyl groups as esterifying moieties. The presence of two or three nicotiny groups in the sesquiterpene core is characteristic of cangorins.

During our studies on biologically active compounds in South American medicinal plants, we have recently been examining plants of the genus *Maytenus* (1–3) of the Celastraceae because of their wide use as folk medicines (4,5). From *Maytenus* species, many characteristic bioactive compounds, such as the maytansinoids (6) with antitumor activity, cytotoxic quinoid triterpenes (1,2,7), sesquiterpene polyesters, and sesquiterpene pyridine alkaloids (3,8), with insect antifeedant or insecticidal activity, have so far been isolated. Immunosuppressive activity was also reported for sesquiterpene pyridine alkaloids (9).

*Maytenus ilicifolia* Mart. is a large shrub found in Southern Brazil, Paraguay, Uruguay, and Argentina. Its reddish to orangish brown root bark, known as “cangorosa,” is used by Indian tribes and rural populations in Paraguay as a fertility regulating agent. In our previous examinations of cytotoxic principles of this material, unique triterpene dimers named cangorosins (1) and the biogenetically important triterpene cangoronine (2) along with some quinoid triterpenes (2) were isolated. In this paper we report the isolation and structure determinations of five new sesquiterpene polyesters from non-cytotoxic fractions of the CHCl<sub>3</sub>-soluble phase of an MeOH extract of *M. ilicifolia*.



	R <sup>1</sup>	R <sup>2</sup>	R <sup>3</sup>
1	OAc	Nic	Nic
2	Nic	Bz	Nic
3	OAc	Bz	Nic
4	OAc	OAc	Nic
5	Nic	OAc	Bz

## RESULTS AND DISCUSSION

A  $\text{CHCl}_3$ -soluble portion of the MeOH extract of the root bark of *M. ilicifolia* (1140 g) was subjected to Si gel cc. The fractions obtained were further separated by Si gel or reversed-phase Si gel medium pressure liquid chromatography (mplc) and/or hplc to give five new sesquiterpene polyesters, cangorins A [**1**] 0.0018%, B [**2**] 0.0016%, C [**3**] 0.0017%, D [**4**] 0.014%, and E [**5**] 0.009%.

Cangorin A was obtained as an amorphous solid with molecular formula  $\text{C}_{44}\text{H}_{43}\text{N}_3\text{O}_{14}$ . It contained two acetyl groups ( $\delta_{\text{H}}$  1.48, 2.08), one benzoyl group [ $\delta_{\text{H}}$  8.06 (*o*), 7.49 (*m*), 7.63 (*p*)], three nicotiny groups [ $\delta_{\text{H}}$  9.35 (H-2'), 8.45 (H-4'), 7.41 (H-5'), and 8.80 (H-6'); 9.28 (H-2'), 8.36 (H-4'), 7.43 (H-5'), and 8.79 (H-6'); 9.49 (H-2'), 8.51 (H-4'), 7.47 (H-5'), and 8.85 (H-6')], three tertiary methyl groups [ $\delta_{\text{H}}$  1.81 (Me-12), 1.68 (Me-13), 1.57 (Me-14)], two sets of methylene protons [ $\delta_{\text{H}}$  2.23 (H<sub>a</sub>-3), 2.40 (H<sub>b</sub>-3); 4.58 (H<sub>a</sub>-15), 5.51 (H<sub>b</sub>-15)], six methine protons [ $\delta_{\text{H}}$  5.79 (H-1), 5.91 (H-2), 6.98 (H-6), 2.70 (H-7), 5.63 (H-8), and 5.85 (H-9)] and one hydroxyl group [ $\delta_{\text{H}}$  2.87 (4-OH)] (Table 1). These data indicated a sesquiterpene polyester, which are often found in Celastraceae plants. The coupling constants among the six methine protons and one set of methylene protons revealed their connections in the dihydroagarofuran core, and nOe data shown in Figure 2 disclosed these orientations at  $1\beta_{\text{eq}}$ ,  $2\beta_{\text{ax}}$ ,  $6\alpha_{\text{eq}}$ ,  $8\beta_{\text{ax}}$ , and  $9\alpha_{\text{ax}}$ . In order to determine the position of each ester group, an HMBC spectrum was recorded. This spectrum (Figure 1) enabled the assignments of the two acetyl groups esterified at positions 1 and 15 and one nicotiny group at position 6. The signals for the benzoyl carbonyl and for one nicotiny carbonyl, which were presumably linked at positions 8 and 9, were exactly overlapped, and a cross peak between the third nicotiny carbonyl carbon and the methine proton at position 2 was not detected. In the NOESY spectrum (Figure 2), cross peaks were observed between the ortho protons of the benzoyl group and the methine proton at position 1, and the methyl group at position 12, locating the benzoyl group at position 9 and the two remaining nicotiny groups at positions 2 and 6. This C-9 benzoyl group gave rise to an unusual diamagnetic effect against an acetyl methyl located on C-1. These spectroscopic data corroborated the structure of cangorin A as **1**.

Cangorin B, an amorphous solid with a molecular formula  $\text{C}_{49}\text{H}_{45}\text{N}_3\text{O}_{14}$ , was also a polyesterified sesquiterpene. The nmr spectrum suggested that the dihydroagarofuran core was esterified with one acetyl, two benzoyl, and three nicotiny groups. The HMBC spectrum showed that one methylene proton of position 15 ( $\delta_{\text{H}}$  5.63) and the acetyl methyl group ( $\delta_{\text{H}}$  2.12) gave cross peaks with the same carbonyl carbon ( $\delta_{\text{C}}$  170.83); thus the acetyl group was located at position 15. Couplings between the ortho protons of the benzoyl groups as well as the oxygenated methines of the sesquiterpene with their respective carbonyl carbons ( $^1\text{H}/^{13}\text{C}/^1\text{H}$  8.19/165.73/6.95 ppm for the C-6-benzoyl; 7.69/164.15/5.91 ppm for the C-9-benzoyl) located and two benzoate esters at C-6 and C-9. Analogously, couplings between the H-4' of one nicotiny group as well as the methine proton of the sesquiterpene core with its respective carbonyl carbon ( $^1\text{H}/^{13}\text{C}/^1\text{H}$  8.53/164.27/5.56 ppm) indicated that one nicotinate ester was at C-8. Though the remaining methine protons at positions 1 and 2 were exactly overlapped in the  $^1\text{H}$ -nmr spectrum, the two remaining nicotiny groups must be located at these positions 1 and 2. Based on these spectroscopic evidence, the structure of cangorin B was determined to be **2**.

Cangorin C, an amorphous solid with a molecular formula  $\text{C}_{45}\text{H}_{44}\text{N}_2\text{O}_{14}$ , also was a sesquiterpene polyester but contained two acetyl, two benzoyl, and two nicotiny groups. Its sesquiterpene core was the same as cangorins A and B. The esterified pattern of the dihydroagarofuran core was determined in the same manner as for cangorins A and B, except for two carbonyl carbons overlapping in the  $^{13}\text{C}$ -nmr spectrum. These two

TABLE 1.  $^1\text{H}$ -nmr Chemical Shifts (ppm) for Cangorins 1-5.<sup>a</sup>

Proton	Compound				
	1	2	3	4	5
H-1	5.79 (d, 3.9)	6.07 (br s)	5.80 (d, 3.9)	5.72 (d, 4.0)	6.04 (br s)
H-2	5.91 (br dd, 2.6, 3.9)	6.07 (br s)	5.91 (br dd, 3.7, 6.5)	5.85 (br dd, 4.0, 6.7)	6.04 (br s)
H <sub>α</sub> -3	2.23 (dd, 2.6, 15.4)	2.31 (dd, 2.0, 15.4)	2.23 (dd, 2.5, 15.4)	2.13 (dd, 2.6, 15.4)	2.24 (dd, 2.0, 15.4)
H <sub>β</sub> -3	2.40 (dd, 4.2, 15.4)	2.52 (dd, 3.5, 15.4)	2.43 (dd, 4.1, 15.4)	2.36 (dd, 4.2, 15.4)	2.48 (dd, 3.2, 15.4)
4-OH	2.87 (s)	2.99 (s)	2.93 (s)	2.80 (s)	2.83 (br s)
H-6	6.98 (s)	6.95 (s)	6.94 (s)	6.71 (s)	6.81 (s)
H-7	2.70 (d, 2.8)	2.73 (d, 2.7)	2.70 (d, 2.6)	2.49 (d, 2.8)	2.55 (d, 2.8)
H-8	5.63 (d, 2.8)	5.56 (d, 2.7)	5.64 (d, 2.6)	5.54 (d, 2.8)	5.58 (d, 2.8)
H-9	5.85 (s)	5.91 (s)	5.86 (s)	5.77 (s)	5.88 (s)
Me-12	1.81 (s)	1.84 (s)	1.80 (s)	1.74 (s)	1.82 (s)
Me-13	1.68 (s)	1.72 (s)	1.70 (s)	1.62 (s)	1.68 (s)
Me-14	1.57 (s)	1.63 (s)	1.59 (s)	1.54 (s)	1.60 (s)
H <sub>α</sub> -15	4.58 (d, 13.0)	4.74 (d, 12.9)	4.62 (d, 13.0)	4.52 (d, 13.0)	4.71 (d, 12.9)
H <sub>β</sub> -15	5.51 (d, 13.0)	5.63 (d, 12.9)	5.50 (d, 13.0)	5.45 (d, 13.0)	5.57 (d, 12.9)
1-OAc	1.48 (s)	—	1.49 (s)	1.43 (s)	—
ONic (2')	—	8.5 <sup>b</sup> (br s)	—	—	8.49 <sup>b</sup> (d, 1.8)
ONic (4')	—	7.59 <sup>b</sup> (d, 7.6)	—	—	7.59 <sup>b</sup> (dt, 1.9, 8.1)
ONic (5')	—	7.09 <sup>b</sup> (br dd, 4.9, 7.3)	—	—	7.07 <sup>b</sup> (dd, 4.8, 7.9)
ONic (6')	—	8.59 <sup>b</sup> (br s)	—	—	8.57 <sup>b</sup> (dd, 1.6, 4.8)
2-ONic (2')	9.35 (br d, 1.0)	9.19 <sup>b</sup> (br s)	9.28 (br s)	9.25 (d, 1.6)	9.19 <sup>b</sup> (d, 1.8)
ONic (4')	8.45 (dt, 1.9, 8.0)	8.27 <sup>b</sup> (d, 7.6)	8.37 (d, 8.0)	8.34 (dt, 1.9, 8.0)	8.29 <sup>b</sup> (dt, 1.9, 8.0)
ONic (5')	7.41 (br d, 5.7)	7.40 <sup>b</sup> (br s)	7.42 (dd, 4.9, 8.0)	7.41 (dd, 4.8, 7.9)	7.40 <sup>b</sup> (dd, 4.8, 7.9)
ONic (6')	8.80 (br dd, 1, 5)	8.79 <sup>b</sup> (br s)	8.79 (br s)	8.78 (dd, 1.7, 4.9)	8.78 <sup>b</sup> (dd, 1.5, 4.8)
6-OAc	—	—	—	2.10 (s)	2.15 (s)
ONic (2')	9.28 (br d, 1.4)	—	—	—	—
ONic (4')	8.36 (dt, 1.9, 8.1)	—	—	—	—
ONic (5')	7.43 (br d, 4.9)	—	—	—	—
ONic (6')	8.79 (br dd, 1.3, 5)	—	—	—	—
OBz (o)	—	8.19 (d, 7.6)	8.18 (d, 7.3)	—	—
OBz (m)	—	7.48 (t-like, 7.7)	7.46 (t-like, 7.6)	—	—
OBz (p)	—	7.60 (t-like, 7.5)	7.62 (t-like, 7.5)	—	—
8-ONic (2')	9.49 (br d, 1.5)	9.50 (br s)	9.50 (br s)	9.36 (d, 1.5)	—
ONic (4')	8.51 (td, 2.0, 8.0)	8.53 (d, 7.6)	8.53 (td, 1.8, 7.9)	8.41 (dt, 2.0, 8.0)	—
ONic (5')	7.47 (d, 7.8)	7.48 (br s)	7.47 (d-like, 7.7)	7.41 (dd, 4.8, 7.9)	—
ONic (6')	8.85 (dd, 1.6, 4.8)	8.86 (br s)	8.85 (br d, 3.9)	8.76 (dd, 1.6, 4.9)	—
OBz (o)	—	—	—	—	8.18 (dd, 1.1, 8.2)
OBz (m)	—	—	—	—	7.48 (t-like, 7.7)
OBz (p)	—	—	—	—	7.60 (t-like, 7.4)
9-OBz (o)	8.06 (dd, 1.2, 8.3)	7.69 (d, 7.7)	8.07 (d, 7.3)	8.01 (dd, 1.1, 8.3)	7.67 (dd, 1.3, 7.8)
OBz (m)	7.49 (dd, 2.0, 7.8)	7.31 (t-like, 7.7)	7.48 (t-like, 7.8)	7.43 (t-like, 7.8)	7.29 (t-like, 7.8)
OBz (p)	7.63 (tt, 1.2, 7.4)	7.54 (t-like, 7.4)	7.59 (t-like, 7.5)	7.58 (tt-like, 1.1, 7.5)	7.52 (t-like, 7.6)
15-OAc	2.08 (s)	2.12 (s)	2.07 (s)	2.03 (s)	2.10 (s)

<sup>a</sup>Measurements performed in CDCl<sub>3</sub> at 400 MHz. Multiplicity and coupling constants (*J* in Hz) given in parentheses.<sup>b</sup>These sets of values may be interchangeable between each group.

carbonyl carbons belonged to one benzoyl and one nicotinyl group, and the two methine protons at positions 8 and 9 gave cross peaks with them. The determination of these ester group positions was accomplished with a NOESY spectrum. The ortho protons of the benzoyl group gave cross peaks with the methyl group at position 12 and the methine proton at position 1, as in cangorin A; thus the benzoyl group must be located at position 9 and the remaining nicotinyl group at position 8. These data confirm that the structure of cangorin C is **3**.

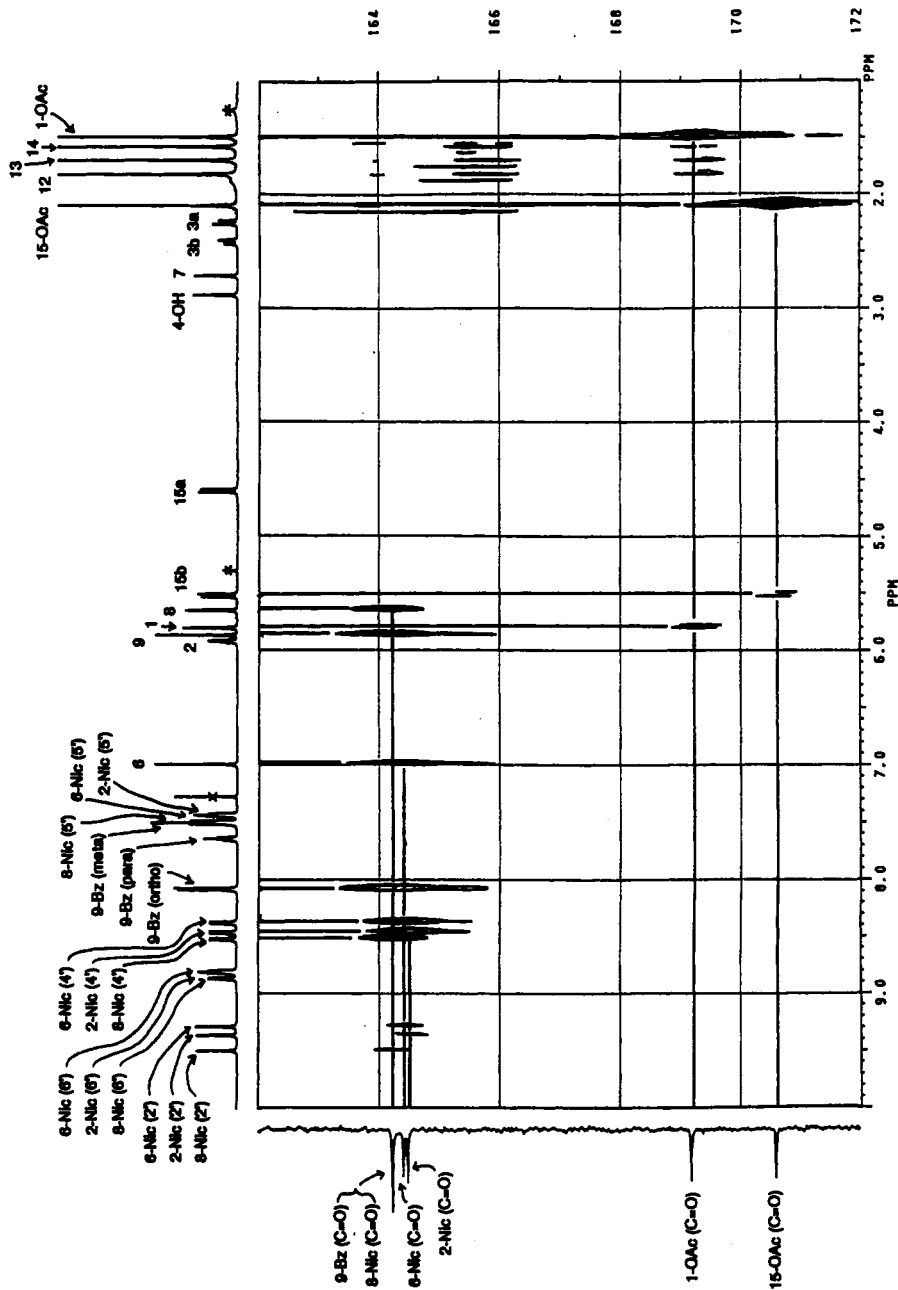


FIGURE 1. Expanded region of the HMBC contour plot of 1.

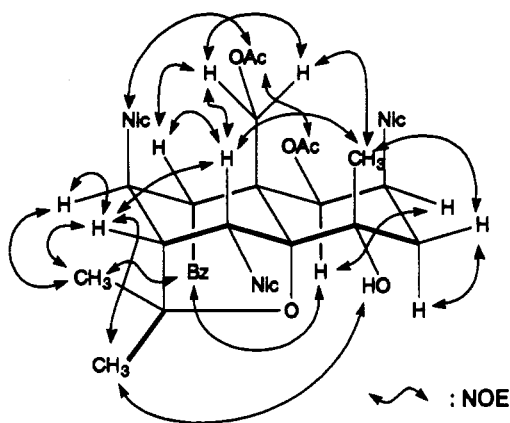


FIGURE 2. Fractional nOe data from NOESY spectrum of **1**.

Cangorins D and E were obtained as amorphous solids, and their molecular formulae were determined to be  $C_{40}H_{42}N_2O_{14}$  and  $C_{45}H_{44}N_2O_{14}$ , respectively. These two cangorins were identical with cangorins A, B, and C with respect to the sesquiterpene core, and their structural differences were in the esterified pattern. These esterification positions were determined by HMBC and NOESY spectra. In cangorin D, a cross peak of the methine proton at position 2 with a nicotinyl group was not detected in the HMBC spectrum. This connection was clarified by a NOESY spectrum which showed that H-2' and H-4' of the nicotinyl group gave cross peaks with the methyl group at position 14 and two methylene protons at position 15. In cangorin E, the two methine protons at positions 1 and 2 were overlapped as in cangorin B, and only one of these showed a cross peak with the corresponding carbonyl carbon in the HMBC spectrum. Fortunately, both of these esters were nicotinyl groups, so these groups must be located at positions 1 and 2. Consequently, the structures of cangorin D and E were determined as **4** and **5**. Complete assignments of the  $^1H$ - and  $^{13}C$ -nmr signals of all cangorins are shown in Tables 1 and 2, respectively.

## EXPERIMENTAL

**GENERAL DETAILS.**—Mp's were determined on a Yanagimoto micro-melting point apparatus and are uncorrected. Optical rotations were measured with a JASCO DIP-4 spectrometer, and the  $[\alpha]_D$  values are given in  $10^{-1} \text{ deg cm}^2 \cdot \text{g}^{-1}$ . Mass spectra and ir spectra were taken with a Hitachi M-80 spectrometer and a Perkin Elmer 1710 spectrophotometer, respectively. Mplc was performed with a CIG column system (22 mm i.d.  $\times$  300 mm, Kusano Scientific, Tokyo) packed with  $10 \mu\text{m}$  Si gel or  $20 \mu\text{m}$  ODS. Hplc was performed with an Inertsil PREP-ODS column (20 mm i.d.  $\times$  250 mm, Gasukuro Kogyo Inc.) packed with  $10 \mu\text{m}$  ODS. Tlc was conducted on precoated Kieselgel 60 F<sub>254</sub> (Art. 5715; Merck) and the spots were detected by heating after spraying with 10%  $H_2SO_4$ .  $^1H$ - and  $^{13}C$ -nmr spectra were recorded on Bruker Spectrometers (AM400 and AM500) at 303K and processed on a Bruker data station with an Aspect 3000 computer. NOESYPH experiments were made with a mixing time of 0.6 sec. The nmr coupling constants ( $J$ ) are given in Hz.

**MATERIALS.**—Reddish to orangish brown root bark of *M. ilicifolia* (1140 g), was purchased at Asuncion, Paraguay, in 1987. The botanical identification was made by Dr. Tanaka (Asuncion University). A voucher specimen has been deposited in the herbarium of the Tokyo College of Pharmacy.

**EXTRACTION AND ISOLATION OF 1-5.**—The root bark (1140 g) of *M. ilicifolia* was crushed and extracted with hot MeOH to give an MeOH extract (364 g) which was partitioned between  $CHCl_3$  and  $H_2O$ . The  $CHCl_3$ -soluble fraction (62.3 g) was subjected to Si gel cc using *n*-hexane-EtOAc (1:0 $\rightarrow$ 0:1) to give seventeen fractions. Non-cytotoxic fractions 12, 13, 14, and 15 were further subjected to an ODS mplc with an MeOH/ $H_2O$  solvent system to give **1-5** as amorphous solids. These compounds were further purified by ODS hplc with MeOH/ $H_2O$  or MeCN/ $H_2O$  solvent systems.

TABLE 2. <sup>13</sup>C-nmr Chemical Shifts (ppm) for Cangorins 1-5.<sup>a</sup>

Carbon	Compound				
	1	2	3	4	5
C-1	70.64 (d)	72.05 (d)	70.77 (d)	70.56 (d)	72.07 (d)
C-2	69.06 (d)	69.39 (d)	69.21 (d)	68.98 (d)	69.46 (d)
C-3	42.70 (t)	42.81 (t)	42.72 (t)	41.92 (t)	42.30 (t)
C-4	69.93 (s)	70.01 (s)	69.99 (s)	69.63 (s)	69.89 (s)
C-5	91.57 (s)	91.62 (s)	91.57 (s)	91.29 (s)	91.74 (s)
C-6	76.16 (d)	75.89 (d)	75.89 (d)	75.19 (d)	75.48 (d)
C-7	53.88 (d)	53.76 (d)	53.87 (d)	53.62 (d)	53.85 (d)
C-8	77.85 (d)	77.79 (d)	77.90 (d)	77.70 (d)	77.3 (d)
C-9	73.09 (d)	73.01 (d)	73.15 (d)	73.04 (d)	73.25 (d)
C-10	54.57 (s)	54.81 (s)	54.61 (s)	54.32 (s)	54.76 (s)
C-11	83.48 (s)	83.62 (s)	83.50 (s)	83.17 (s)	83.57 (s)
C-12	25.86 (q)	25.93 (q)	25.90 (q)	25.68 (q)	25.99 (q)
C-13	29.67 (q)	29.65 (q)	29.67 (s)	29.32 (q)	29.57 (t)
C-14	24.37 (q)	24.60 (q)	24.49 (q)	24.60 (q)	24.90 (q)
C-15	66.32 (t)	66.47 (t)	66.33 (t)	66.19 (t)	66.57 (t)
1-OC=O	169.29 (s)	163.91 <sup>b</sup> (s)	169.33 (s)	169.10 (s)	163.86 <sup>b</sup> (s)
Me	20.37 (q)	—	20.39 (q)	20.18 (q)	—
2'	—	150.46 <sup>b</sup> (s)	—	—	150.49 <sup>b</sup> (s)
3'	—	125.0 <sup>b</sup> (s)	—	—	124.96 <sup>b</sup> (s)
4'	—	136.35 <sup>b</sup> (d)	—	—	136.38 <sup>b</sup> (d)
5'	—	122.9 <sup>b</sup> (d)	—	—	122.85 <sup>b</sup> (d)
6'	—	153.43 <sup>b</sup> (d)	—	—	153.39 <sup>b</sup> (d)
2-OC=O	164.58 (s)	164.45 <sup>b</sup> (s)	164.56 (s)	164.33 (s)	164.44 <sup>b</sup> (s)
2'	151.63 (d)	151.11 <sup>b</sup> (d)	151.24 (d)	151.00 (d)	151.17 <sup>b</sup> (d)
3'	125.58 (s)	125.2 <sup>b</sup> (s)	125.40 (s)	125.23 (s)	125.22 <sup>b</sup> (s)
4'	137.65 (d)	137.05 <sup>b</sup> (d)	137.17 (d)	137.03 (d)	137.10 <sup>b</sup> (s)
5'	123.61 (d)	123.5 <sup>b</sup> (d)	123.62 (d)	123.27 (d)	123.66 <sup>b</sup> (s)
6'	154.0 (d)	154.02 <sup>b</sup> (s)	153.96 (d)	153.78 (d)	154.08 <sup>b</sup> (s)
6-OC=O	169.93 (s)	165.73 (s)	165.75 (s)	169.72 (s)	169.81 (s)
Me	—	—	—	21.33 (q)	21.58 (q)
2'	151.21 (d)	—	—	—	—
3'	125.31 (s)	—	—	—	—
4'	137.17 (d)	—	—	—	—
5'	123.61 (d)	—	—	—	—
6'	154.0 (d)	—	—	—	—
ipso	—	129.55 (s)	129.63 (s)	—	—
ortho	—	130.26 (d)	130.33 (d)	—	—
meta	—	128.78 (d)	128.76 (d)	—	—
para	—	133.64 (d)	134.05 (d)	—	—
8-OC=O	170.02 (s)	164.27 (s)	164.38 (s)	164.07 (s)	165.52 (s)
2'	151.41 (d)	151.50 (d)	151.49 (d)	151.13 (s)	—
3'	125.82 (s)	126.0 (s)	125.96 (s)	125.62 (s)	—
4'	137.60 (d)	137.63 (d)	137.65 (d)	137.30 (d)	—
5'	123.50 (d)	123.5 (d)	123.48 (d)	123.47 (d)	—
6'	154.0 (d)	154.02 (d)	153.96 (d)	153.78 (d)	—
ipso	—	—	—	—	129.75 (s)
ortho	—	—	—	—	130.13 (d)
meta	—	—	—	—	128.55 (d)
para	—	—	—	—	133.60 (d)
9-OC=O	164.33 (s)	164.15 (s)	164.38 (s)	164.20 (s)	164.14 (s)
ipso	128.38 (s)	128.04 (s)	128.51 (s)	128.23 (s)	128.21 (s)
ortho	130.30 (d)	130.06 (d)	130.25 (d)	130.10 (d)	130.06 (d)
meta	128.65 (d)	128.38 (d)	128.65 (d)	128.46 (d)	128.33 (d)
para	134.09 (d)	133.87 (d)	133.58 (d)	133.87 (d)	133.76 (d)
15-OC=O	170.71 (s)	170.83 (s)	170.75 (s)	170.56 (s)	170.99 (s)
Me	21.20 (q)	21.24 (q)	21.20 (q)	20.97 (q)	21.15 (q)

<sup>a</sup>Measurements performed in CDCl<sub>3</sub> at 100 MHz. Multiplicity given in parentheses.<sup>b</sup>These sets of values may be interchangeable between each group.

*Cangorin A* [1].—Colorless amorphous solid: mp 136–140°,  $[\alpha]_D +45.7^\circ$  ( $c=0.37$ ,  $\text{CHCl}_3$ ),  $\lambda$  max (MeOH) nm ( $\Delta\epsilon$ ) 234 (–6.3), 216 (+7.4), 208 (+4.6), ms  $m/z$   $[\text{M}]^+$  837, 822, 778, 731, 714, 673, 591, 328, 229, 124, 105 (found  $[\text{M}+\text{H}]^+$  838.2773;  $\text{C}_{44}\text{H}_{44}\text{N}_3\text{O}_{14}$  requires 838.2823);  $\nu$  max ( $\text{CHCl}_3$ )  $\text{cm}^{-1}$  3570 (w), 1729 (br s), 1593 (s), 1423 (s), 1369 (s), 1278 (br s),  $\lambda$  max (MeOH) nm (log  $\epsilon$ ) 203 (4.37), 222 (4.57), 258 (4.00), 262 (4.02), 268 (3.94);  $^1\text{H}$  nmr ( $\text{CDCl}_3$ ) see Table 1;  $^{13}\text{C}$  nmr ( $\text{CDCl}_3$ ) see Table 2.

*Cangorin B* [2].—Colorless amorphous solid: mp 137–141°,  $[\alpha]_D +77.3^\circ$  ( $c=0.33$ ,  $\text{CHCl}_3$ );  $\lambda$  max (EtOH) nm ( $\Delta\epsilon$ ) 282 (–1.0), 242 (+10.7), 223 (–17.4), ms  $m/z$   $[\text{M}]^+$  899, 884, 794, 776, 720, 654, 602, 487, 269, 124, 105 (found  $[\text{M}+\text{H}]^+$  900.2962;  $\text{C}_{49}\text{H}_{46}\text{N}_3\text{O}_{14}$  requires 900.2980),  $\nu$  max ( $\text{CHCl}_3$ )  $\text{cm}^{-1}$  3570 (w), 1741 (br s), 1593 (s), 1423 (s), 1284 (br s),  $\lambda$  max (EtOH) nm (log  $\epsilon$ ) 203 (4.44), 224 (4.61), 258 (3.98), 263 (3.99);  $^1\text{H}$  nmr ( $\text{CDCl}_3$ ) see Table 1,  $^{13}\text{C}$  nmr ( $\text{CDCl}_3$ ) see Table 2.

*Cangorin C* [3].—Colorless amorphous solid: mp 122–126°,  $[\alpha]_D +45.0^\circ$  ( $c=0.36$ ,  $\text{CHCl}_3$ );  $\lambda$  max (MeOH) nm ( $\Delta\epsilon$ ) 233 (–8.8), 216 (+7.0), 208 (+4.3), ms  $m/z$   $[\text{M}]^+$  836, 713, 657, 591, 424, 228, 124, 105 (found  $[\text{M}+\text{H}]^+$  837.2877;  $\text{C}_{43}\text{H}_{43}\text{N}_2\text{O}_{14}$  requires 837.2871),  $\nu$  max ( $\text{CHCl}_3$ )  $\text{cm}^{-1}$  3569 (w), 1741 (br s), 1592 (s), 1423 (s), 1369 (s), 1284 (br s);  $\lambda$  max (MeOH) nm (log  $\epsilon$ ) 203 (4.39), 227 (4.57), 262 (3.87), 268 (3.81), 281 (3.38);  $^1\text{H}$  nmr ( $\text{CDCl}_3$ ) see Table 1,  $^{13}\text{C}$  nmr ( $\text{CDCl}_3$ ) see Table 2.

*Cangorin D* [4].—Colorless amorphous solid: mp 123–128°,  $[\alpha]_D +11.2^\circ$  ( $c=0.20$ ,  $\text{CHCl}_3$ ),  $\lambda$  max (MeOH) nm ( $\Delta\epsilon$ ) 235 (–5.4), 216 (+5.3), 208 (+3.7), ms  $m/z$   $[\text{M}]^+$  774, 759, 732, 651, 609, 484, 407, 368, 228, 202, 166, 124, 105 (found  $[\text{M}+\text{H}]^+$  775.2672;  $\text{C}_{46}\text{H}_{43}\text{N}_2\text{O}_{14}$  requires 775.2714),  $\nu$  max ( $\text{CHCl}_3$ )  $\text{cm}^{-1}$  3568 (w), 1735 (br s), 1592 (s), 1423 (s), 1370 (s), 1235 (br s),  $\lambda$  max (MeOH) nm (log  $\epsilon$ ) 202 (4.28), 223 (4.35), 257 (3.75), 262 (3.76), 268 (3.70), 281 (3.14);  $^1\text{H}$  nmr ( $\text{CDCl}_3$ ) see Table 1,  $^{13}\text{C}$  nmr ( $\text{CDCl}_3$ ) see Table 2.

*Cangorin E* [5].—Colorless amorphous solid: mp 103–108°,  $[\alpha]_D +26.3^\circ$  ( $c=0.19$ ,  $\text{CHCl}_3$ ),  $\lambda$  max (MeOH) nm ( $\Delta\epsilon$ ) 285 (–0.5), 263 (+4.4), 252 (+3.6), 239 (–2.7), 232 (–1.2), ms  $m/z$   $[\text{M}]^+$  836, 821, 714, 672, 547, 470, 429, 355, 281, 202, 147, 124, 105 (found  $[\text{M}+\text{H}]^+$  837.2874;  $\text{C}_{43}\text{H}_{43}\text{N}_2\text{O}_{14}$  requires 837.2871);  $\nu$  max ( $\text{CHCl}_3$ )  $\text{cm}^{-1}$  3562 (w), 1734 (br s), 1592 (s), 1423 (s), 1370 (s), 1237 (br s);  $\lambda$  max (MeOH) nm (log  $\epsilon$ ) 203 (4.38), 225 (4.49), 263 (3.83), 269 (3.76), 281 (3.34);  $^1\text{H}$  nmr ( $\text{CDCl}_3$ ) see Table 1;  $^{13}\text{C}$  nmr ( $\text{CDCl}_3$ ) see Table 2.

#### LITERATURE CITED

1. H. Itokawa, O. Shirota, H. Morita, K. Takeya, N. Tomioka, and A. Itai, *Tetrahedron Lett.*, **31**, 6881 (1990).
2. H. Itokawa, O. Shirota, H. Morita, K. Takeya, and Y. Iitaka, *Phytochemistry*, **30**, 3713 (1991).
3. H. Itokawa, O. Shirota, H. Morita, and K. Takeya, *Heterocycles*, **34**, 885 (1992).
4. F.A. Flores, "Advances in Economic Botany," The New York Botanical Garden, 1984, Vol. 1, pp. 1–8.
5. J.G. Gonzalez, G.D. Monache, F.D. Monache, and G.B. Marini-Bettolo, *J. Ethnopharmacol.*, **5**, 73 (1982).
6. S.M. Kupchan, Y. Komoda, W.A. Court, G.J. Thomas, R.M. Smith, A. Karim, C.J. Gilmore, R.C. Haltiwanger, and R.F. Bryan, *J. Am. Chem. Soc.*, **94**, 1354 (1972).
7. K. Nakanishi, V.P. Gullo, I. Miura, T.R. Govindachari, and N. Visivanathan, *J. Am. Chem. Soc.*, **95**, 6473 (1973).
8. F.D. Monache, G.B. Marini-Bettolo, and E.A. Bernays, *Angew. Entomol.*, **97**, 406 (1984).
9. Y.L. Zheng, Y. Xu, and J.F. Lin, *Acta Pharm. Sin.*, **24**, 568 (1989).

Received 28 December 1992