

A stilbene dimer, andalasin B, from the root trunk of *Morus macrourea*

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A new stilbene dimer, andalasin B, was isolated from the root trunk of *Morus macrourea* Miq., together with three known compounds, andalasin A, lunularin, oxyresveratrol, and β -resorcylaldehyde.

Keywords: stilbene dimer, andalasin B, *Morus macrourea*

The oligostilbenoids isolated from members of the Dipterocarpaceae, Gnetaceae, Vitaceae, and Leguminosae are of interest because they exhibit antimicrobial and cytotoxic activity.^{1,2} Prenylated stilbenes, Diels–Alder adducts, and prenylated 2-arylbenzofurans also occur in members of the Moraceae.^{3–5} Recently, andalasin A (**1**),⁶ a stilbene dimer, and macrouirin B (**2**),⁷ a benzofuran-stilbene derivative, were isolated from the heartwood and tree bark, respectively, of *Morus macrourea* Miq. In addition, another stilbene dimer, artogomezianol, was characterised from a member of the allied genus, *Artocarpus gomezianus*.⁸ In our search for further oligostilbenes from moraceaeous plants, we have examined the root trunk of *M. macrourea*. We now report the isolation of a new stilbene dimer, which we have named andalasin B (**3**), along with the known phenolic compounds **1**, lunularin, oxyresveratrol, and β -resorcylaldehyde.

The dried powdered root trunk of *M. macrourea* was macerated with MeOH, and the MeOH-extract was partitioned into hexane, CH₂Cl₂, and EtOAc soluble fractions. The EtOAc fraction was fractionated using silica gel chromatography and the fraction rich in phenolic compounds and more polar than oxyresveratrol, was repeatedly purified by radial chromatography to give compounds **1** and **3**. Using the same methodology, lunularin and β -resorcylaldehyde were isolated from the CH₂Cl₂ fraction. Compound **3**, obtained as brownish-yellow solid, had a molecular formula C₂₈H₂₂O₈ [[M]⁺ ion at *m/z* 486.1332 (calcd. 486.1315)]. The UV spectrum of **3** (see Experimental) showed absorption maxima characteristic of a stilbene chromophore. The IR spectrum of **3** exhibited absorptions for hydroxyl and aromatic functionalities. A dimeric stilbenoid structure was suggested by this data for compound **3**. The ¹H NMR spectrum of **3** resembles those of ϵ -viniferin⁹ and the resveratrol (*E*)-dehydrodimer (**4**),¹⁰ and revealed signals assignable to two 3,5-dihydroxyphenyl (δ_{H} 6.52 and 6.19, each 2H, d, *J*=2.2 Hz; 6.26 and 6.22, each 1H, t, *J*=2.2 Hz), a 3,4-dihydroxyphenyl (δ_{H} 6.85, d, *J*=2.0 Hz; 6.82, d, *J*=8.1 Hz; 6.72, dd, *J*=8.0, 2.0 Hz; each 1H), and a *trans*-vinyl (δ_{H} 7.40 and 6.87, each 1H, d, *J*=16.5 Hz) groups. In addition, a pair of signals for two aliphatic methines (δ_{H} 5.34 and 4.34, each 1H, d, *J*=7.1 Hz) and signals for 1,2,4,5-tetrasubstituted benzene (δ_{H} 7.27 and 6.47, each 1H, s) were observed. From these data, the basic structure **3** was formulated for andalasin B. The ¹³C NMR data (Table 1) supported structure **3**, showing signals for eight oxyaryl carbons (δ_{C} 146.0, 146.1, 156.8, 159.5 (2C), 159.9 (2C), 161.6) and two signals (δ_{C} 94.5 and 57.5) characteristic for two methine carbons of a 1,2-diaryl-1,2-dihydrobenzofuran moiety. In addition, two signals at δ_{C} 146.0, 146.1 indicated the presence of an *ortho*-dihydroxyphenyl group (ring A) in **3**. Further support for structure **3** came from HSQC and HMBC measurements (Fig. 1). Supporting evidence was also obtained from a comparison of NMR data between compounds **3** and

Table 1 ¹³C NMR data of compounds **3** and **4** [δ_{C} values (ppm)]^a

Carbon	3	4	Carbon	3	4
1a	133.8	131.6	1b	118.5	130.9
2a	113.9	127.6	2b	156.8	127.8
3a	146.0	115.3	3b	97.8	109.3
4a	146.1	157.6	4b	161.6	159.5
5a	116.0	115.3	5b	123.0	131.3
6a	118.8	127.6	6b	123.3	122.9
7a	94.5	93.1	7b	124.2	128.0
8a	57.5	57.0	8b	126.3	126.4
9a	146.2	144.1	9b	141.6	139.7
10a,14a	107.2	106.4	10b,14b	105.5	104.6
11a,13a	159.7	158.9	11b,13b	159.5	158.7
12a	102.2	101.5	12b	102.4	101.9

^aMeasured in [⁶H]acetone.

4.¹⁰ There was good agreement in their carbon chemical shifts, especially those involving rings A2, B2, and the dihydrofuran ring. The relative stereochemistry at C-7a and C-8a was shown to be *trans* from the NOESY spectrum which showed correlations between H-7a/H-10a,14a and H-8a/H-2a,6a. Accordingly, structure **3** was assigned to andalasin B.

Experimental

M.p.s were determined on Fischer John Melting Point Apparatus and are uncorrected. UV spectra were measured with a Varian Conc. 100 instrument. IR spectra were determined with a Perkin Elmer FTIR Spectrum One spectrometer using KBr pellets. ¹H and ¹³C NMR spectra were recorded with a Bruker AM 500 operating at 500 (¹H) and 125 (¹³C) MHz using residual and deuterated solvent peaks as reference standards. Low and high resolution mass spectra were obtained with VG Autospec mass spectrometer (EI mode). Vacuum liquid (VLC) and column chromatography were carried out using Merck silica gel 60 GF₂₅₄ and silica gel G60 35–70 mesh. For TLC analysis, precoated silica gel plates (Merck Kieselgel 60 GF₂₅₄, 0.25 mm) were used.

Isolation: The dried powdered root-trunk (4.9 kg), collected from Paninjauan village, Sepuluh Koto, Tanah Datar Districts, West Sumatera, Indonesia, in May 1997, was macerated in methanol, and the methanol extract (460 g) was partitioned into *n*-hexane (11 g), CH₂Cl₂ (35 g) and EtOAc (200 g) soluble fractions. A portion (43 g) of the EtOAc fraction was fractionated by VLC (silica gel, *n*-hexane-EtOAc = 1:1 to 1:4) into three fractions. The third fraction (24 g) was repeatedly purified either by VLC or radial chromatography (silica gel) using solvent systems of *n*-hexane-diisopropyl ether (2:8 to 1:9), CHCl₃-MeOH (9:1), and *n*-hexane-CH₂Cl₂-MeOH (6:11:3) to give compound **1** (11 mg), andalasin A⁶ (22 mg) and oxyresveratrol⁶ (4 g). Using the same method, β -resorcylaldehyde (55 mg) and lunularin¹² (135 mg) were isolated from the CH₂Cl₂ fraction.

Andalasin B (3) was obtained as brownish yellow solid, [α]_D +1.2 (MeOH, *c* 0.6); ν_{max} /cm⁻¹ (KBr) 3421, 1615; λ_{max} /nm (log ϵ) (MeOH) 204 (4.68), 292 (4.04), 338 (4.09); (MeOH+NaOH) 206 (5.03), 296 (4.11), 345 (4.04); δ_{H} (500 MHz, [⁶H]acetone) see text; δ_{C} (125 MHz, [⁶H]acetone) see Table 1; *m/z* found: [M]⁺ 486.1332. C₂₈H₂₂O₈ requires *M*, 486.1315.

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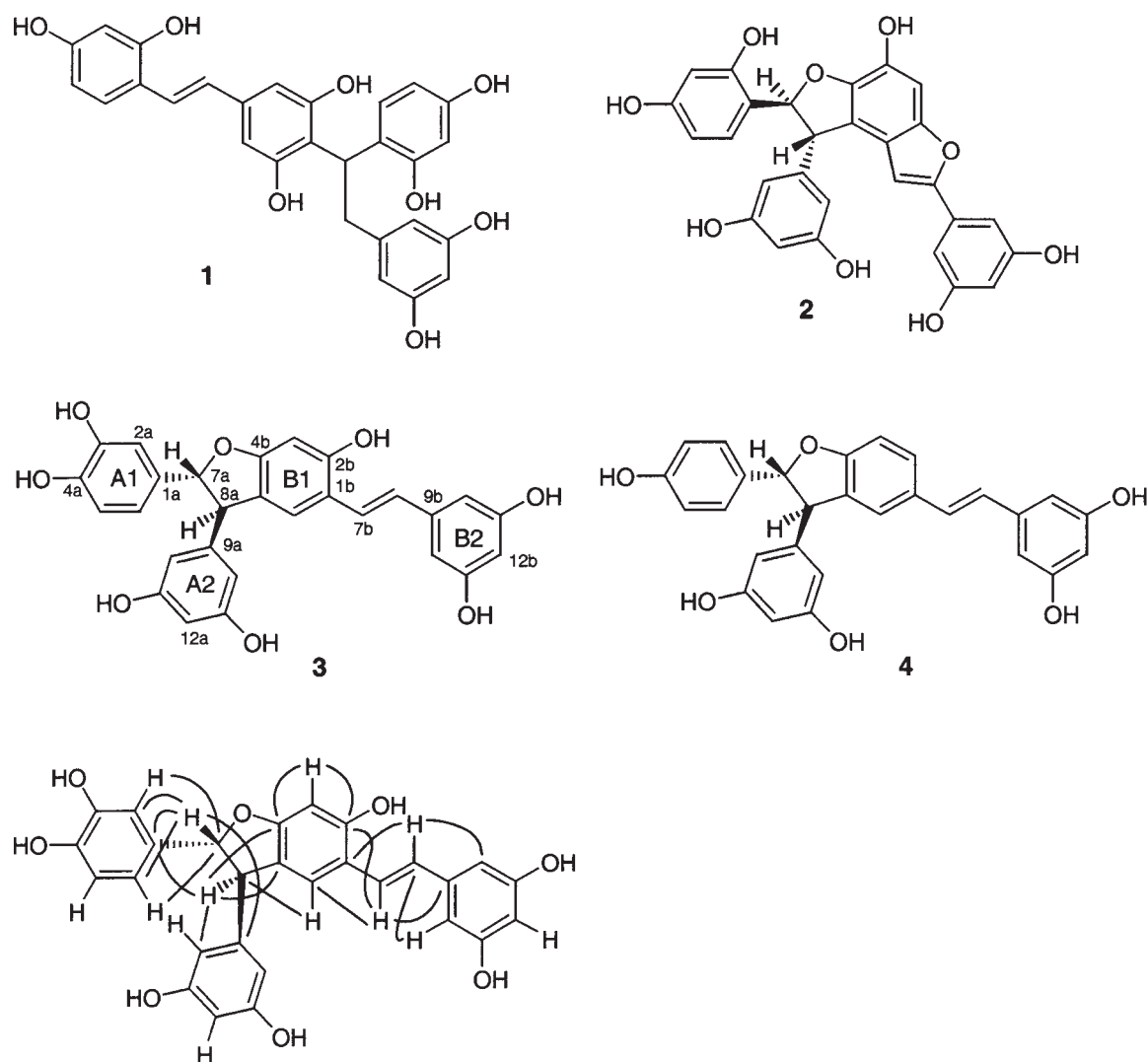


Fig. 1 Selected HMBC correlations in 3.

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