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MAHAGONIN, A NOVEL DIMERIC TETRANORTRITERPENOID FROM SWIETENIA MAHAGONI JACQ.

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Summary: Mahagonin, a novel dimeric tetranortriterpenoid, has been isolated from the seeds of Swietenia mahagoni and its structure was determined to be 1a on the basis of spectroscopic evidence and chemical correlation with 3-O-acetylswietenolide (3a).

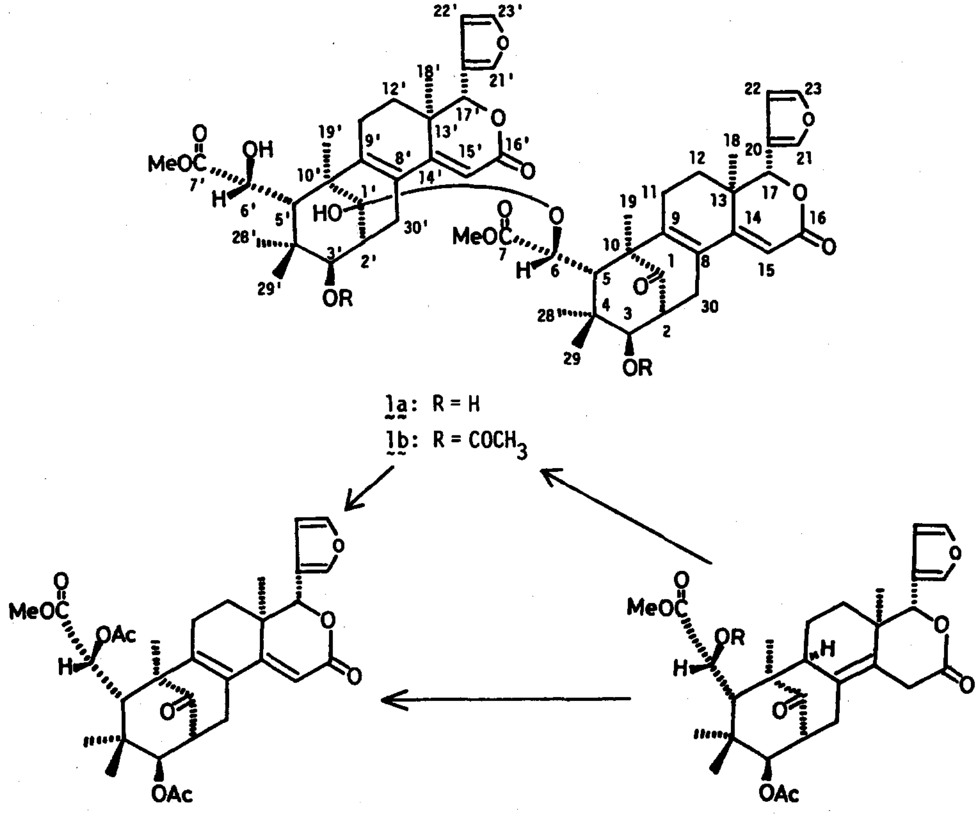
In previous papers,1) we reported the isolation and structure determination of eighteen new tetranortriterpenoids together with ten known compounds from the seeds of Swietenia mahagoni JACQ. Among these, several new compounds were found to have an antagonistic effect on platelet-activating factor (PAF).1,2) In a continuing investigation of an oily fraction from the ether extract, we have isolated a novel dimeric tetranortriterpenoid, named mahagonin (1a). This paper deals with the structure elucidation of 1a.

Mahagonin (1a), colorless needles, mp 178-180°C, $[\alpha]_D$ +170.5° (MeOH), showed UV absorptions (EtOH) at 212 and 292 nm (log ε: 4.16 and 4.37) and IR absorptions (KBr) at 3450 (OH), 1720 (unsaturated lactone), 1620 (double bond), and 870 cm^{-1} (furan). The FAB-MS of 1a exhibited the $(M+H)^+$ peak at m/z 969 and the molecular formula was determined to be $C_{54}H_{64}O_{16}$ [$(M+H)^+$ 969.4232, Calcd 969.4273] by high-resolution FAB-MS.

The ^1H- and ^{13}C-NMR spectra of 1a, analyzed with the aid of ^1H-^1H and ^1H-^{13}C COSY3), indicated the presence of a ketone (δ_C 214.16), two methyl esters (δ_H 3.74 and 3.79; δ_C 52.02, 52.67, 173.11, and 175.94), two α,β-unsaturated lactones (δ_H 5.09, 5.10, 5.88, and 5.91; δ_C 80.64, 80.72, 109.34, 110.33, 165.96, and 166.62), two furans (δ_H 6.45, 7.43, 7.44 and 7.49; δ_C 109.98, 110.04, 119.96, 120.06, 141.19, 141.22, 142.97, and 143.06), two tetrasubstituted olefins (δ_C 126.91, 127.17, 147.19, and 151.04), and four oxygenated methines (δ_H 4.30, 4.34, 4.37, and 4.89; δ_C 70.23, 73.95, 76.24, and 76.50) together with eight tert-methyl groups and six quaternary sp^3 carbons (Table I). Furthermore, the ^{13}C-NMR spectrum showed a characteristic signals at δ_C 105.35 due to a quaternary carbon, which may be assigned to a ketal carbon. These NMR data suggested that 1a may be a dimeric tetranortriterpenoid.

In the ^1H-^{13}C long-range COSY3) of 1a, the ^{13}C-signals at δ 165.96 (s, C-16) and at δ 158.60 (s, C-14) showed long-range correlations with the ^{1}H-signals at δ 5.88 (15-H) and at δ 1.04 (18-H_3) and 1.45 (12-H), respectively, while the ^{13}C-signals at δ 127.17 (s, C-8) and δ 151.04 (s, C-9) were correlated with the ^{1}H-signals at δ 3.32 (30-H) and 5.88 (15-H) and at δ 1.25 (19-H_3) and 1.58 (12-H), respectively. Similarly, the ^{13}C-signals at δ 166.62 (s, C-16'), at δ 157.71 (s, C-14'), at δ 126.91 (s, C-8'), and at δ 147.19 (s, C-9') showed long-range correlations with the ^{1}H-signals at δ 5.91 (15'-H), at δ 0.99 (18'-H_3) and 1.55 (12'-H), at δ 2.77 (30'-H) and 5.91 (15'-H), and at δ 1.31 (19'-H_3) and 1.39 (12'-H), respectively. Thus, the tetrasubstituted double bonds must be conjugated with the α,β-unsaturated lactones. Some other significant long-range correlations observed are shown by arrows in Fig. 1.

Acetylation of mahagonin (1a)(10 mg) gave 3,3'-O,O-diacetylmahagonin (1b)(8.1 mg), mp 148-150°C, $[\alpha]_D$ +91.5° ($CHCl_3$), FAB-MS m/z: 1053 $(M+H)^+$, and a small amount of monomeric compound diacetate (2)(1.3 mg),



1a: R = H

1b: R = $COCH_3$

2

3a: R = H

3b: R = $COCH_3$

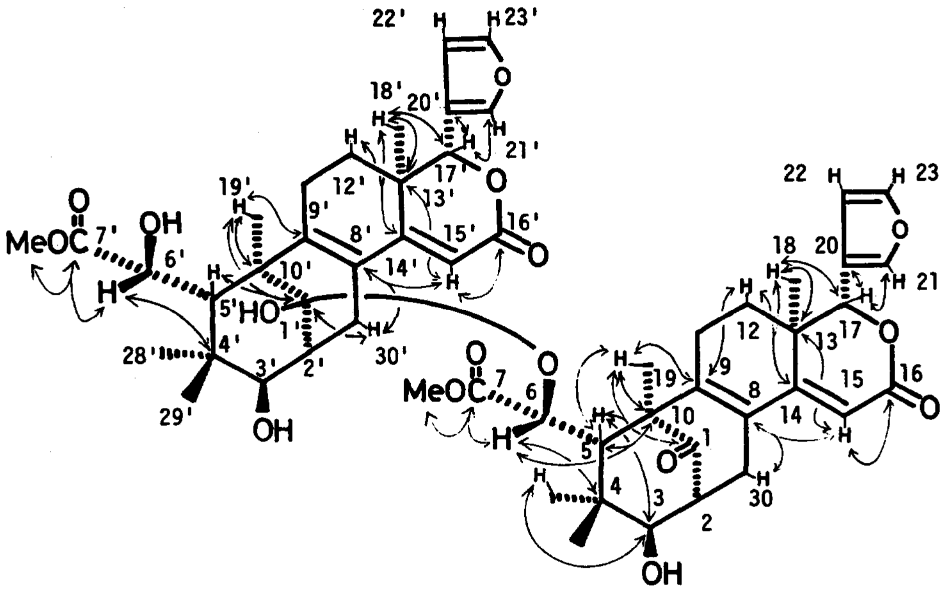


Fig. 1. Significant Long-range Correlations Observed in the ^{1}H-^{13}C Long-range COSY Spectrum

$C_{31}H_{36}O_{10}$[M$^+$ (EI-MS) 568.2289, Calcd 568.2307], mp 140-142°C, $[\alpha]_D$ +85.2° ($CHCl_3$). The latter showed UV absorptions at 213 and 282 nm (log ε: 3.84 and 4.11) and ^{13}C- and ^{1}H-NMR signals due to a ketone (δ_C 210.76) and two acetyl groups (Table I). Eventually, this compound (2) was identified with the dehydrogenation product (2), mp 137-138°C, $[\alpha]_D$ +86.8° ($CHCl_3$), MS m/z: 568 (M$^+$, $C_{31}H_{36}O_{10}$), derived from 3,6-O,O-diacetylswietenolide (3b)1) by treatment with N-bromosuccinimide in boiling carbon tetrachloride under UV irradiation.4)

Similarly, reaction of 3-O-acetylswietenolide (3a)(60 mg) with N-bromosuccinimide under UV irradiation gave a dimer (1b)(9.8 mg), mp 146-147°C, $[\alpha]_D$ +90.5° ($CHCl_3$), which was found to be identical with 3,3'-O,O-diacetylmahagonin (1b) by ^{1}H- and ^{13}C-NMR comparisons.

From the foregoing evidence, the structure of mahagonin was established to be 1a except for the stereochemistry at the C-1' position. Our present result provided the first example of a dimeric tetranortriterpenoid,5) which is unique in the structural feature having an hemiketal linkage between the 6-hydroxy group and 1'-ketone group. The anti-PAF activity of this compound is currently under investigation.

Table I. ^{1}H- and ^{13}C-NMR Data for Mahagonin (1a) and the Compound 2 (in CDCl$_3$)

	1a					2		
Position	δ H	δ C	Position	δ H	δ C	Position	δ H	δ C
1	—	214.16 s	1'	—	105.35 s	1	—	210.76 s
2	3.04 t (6.5)	50.38 d	2'	2.80 t (7.0)	45.23 d	2	3.18 t (6.5)	47.10 d
3	4.34 d (6.5)	76.24 d	3'	4.30 d (7.0)	73.95 d	3	5.44 d (6.5)	77.26 d
4	—	39.74 s	4'	—	39.63 s	4	—	38.60 s
5	2.73 s	56.58 d	5'	2.48 d (4.0)	60.68 d	5	2.95 s	55.29 d
6	4.37 s	70.23 d	6'	4.89 d (4.0)	76.50 d	6	5.49 s	69.96 d
7	—	175.94 s	7'	—	173.11 s	7	—	170.84 s
8	—	127.17 s	8'	—	126.91 s	8	—	126.94 s
9	—	151.04 s	9'	—	147.19 s	9	—	150.54 s
10	—	51.27 s	10'	—	50.15 s	10	—	51.00 s
11	2.34 m	22.25 t	11'	2.15 m 2.48 m	23.84 t	11	2.36 m	22.34 t
12	1.45 m 1.58 m	29.64 t	12'	1.39 m 1.55 m	29.31 t	12	1.46 ddd (12, 7, 5) 1.63 ddd (12, 5, 2)	29.78 t
13	—	36.91 s	13'	—	36.73 s	13	—	36.78 s
14	—	158.60 s	14'	—	157.71 s	14	—	157.12 s
15	5.88 s	110.33 d	15'	5.91 s	109.34 d	15	5.86 s	110.88 d
16	—	165.96 s	16'	—	166.62 s	16	—	165.36 s
17	5.10[a] s	80.64[c] d	17'	5.09[a] s	80.72[c] d	17	5.10 s	80.72 d
20	—	119.96[d] s	20'	—	120.06[d] s	20	—	119.90 s
21	7.49 m	141.19[e] d	21'	7.49 m	141.22[e] d	21	7.50 dd (1.8, 1)	141.19 d
22	6.45 m	109.98[f] d	22'	6.45 m	110.04[f] d	22	6.45 dd (1.8, 1)	109.95 d
23	7.43[b] t (1.8)	142.97[g] d	23'	7.44[b] t (1.8)	143.06[g] d	23	7.45 t (1.8)	143.20 d
18	1.04 s	16.34 q	18'	0.99 s	16.07 q	18	1.00 s	16.15 q
19	1.25 s	18.52 q	19'	1.31 s	18.93 q	19	1.20 s	18.33 q
28	1.08 s	28.09 q	28'	1.00 s	29.78 q	28	1.02 s	27.97 q
29	0.94 s	23.36 q	29'	1.13 s	25.63 q	29	1.23 s	26.62 q
30	2.52 ddd (17.5, 6.5, 2) 3.32 dt (17.5, 2)	29.49 t	30'	2.41 m 2.77 dd (13.5, 7)	23.65 t	30	2.58 ddt (17.5, 6.5, 2) 3.03 dt (17.5, 2)	29.78 t
7-O$\underline{\mathrm{CH}}_3$	3.79 s	52.67 q	7'-O$\underline{\mathrm{CH}}_3$	3.74 s	52.02 q	7-O$\underline{\mathrm{CH}}_3$	3.74 s	52.85 q
						OCO$\underline{\mathrm{CH}}_3$	2.12 s 2.16 s	20.47 q 20.94 q
						O$\underline{\mathrm{C}}$OCH$_3$	—	169.18 s 169.73 s

Coupling constants (Hz) in parenthesis. The multiplicities of carbon signals were determined by means of the DEPT method, and are indicated as s, d, t, and q. a - g) Assignments may be interchanged.

References and Note

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