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NEOFLAVONES. 1. NATURAL DISTRIBUTION AND SPECTRAL AND BIOLOGICAL PROPERTIES

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Data on neoflavones isolated from 58 plants belonging to the Clusiaceae, Fabaceae, Rubiaceae, Thelypteridaceae, Passifloraceae, Asteraceae, and Rutaceae families from the literature up to 2002 were systematized and reviewed. A list of 131 4-phenylcoumarins with information on the plant sources, structures, physicochemical data, and pharmacological properties with references to the original literature was composed.

Keywords: Clusiaceae, Fabaceae, Rubiaceae, Thelypteridaceae, Passifloraceae, Asteraceae, Rutaceae, flavonoids, neoflavones, 4-phenylcoumarins

Flavonoids are one of the most widely distributed groups of phenolic compounds with the structural formula C_6—C_3—C_6. The flavonoid molecule consists of two phenyl rings bonded to a 3-carbon aliphatic moiety. Most flavonoids can be viewed as chromone or chromane derivatives containing an aryl group in the 2, 3, or 4 position.

Neoflavonoids represent a group of natural compounds that also belongs to the flavonoid class. They are based on the 4-phenylcoumarin skeleton. Neoflavonoids include 4-arylcoumarins (neoflavones), 4-arylchromanes, dalbergiones, and dalbergiquinols. A total of 130 representatives of natural 4-arylcoumarins is known (in 2001). The unique structure, broad popularity in traditional plant medicines containing these compounds, and the valuable pharmacological properties make neoflavones highly interesting.

NATURAL DISTRIBUTION

The first neoflavone isolated from natural sources was calophyllolide (**73**). It was isolated in 1951 from extracts of *Calophyllum inophyllum* seeds [1]. Its structure was established in 1957. Neoflavones were recognized as a new group of natural compounds in the mid-60s after several compounds based on 4-phenylcoumarin were isolated from plants of the *Dalbergia* and *Mammea* genera. Neoflavones were isolated from 58 plants of the Clusiaceae, Fabaceae, Rubiaceae, Asteraceae, Thelypteridaceae, Passifloraceae, and Rutaceae families. Dalbergin (**28**) is the most common and widely distributed neoflavone in the plant kingdom.

Data for natural 4-phenylcoumarins have been reviewed [2-4]. We present physicochemical data for neoflavones isolated from plant sources.

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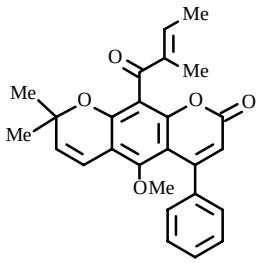
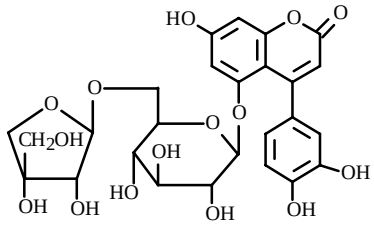
PHYSICAL CONSTANTS AND SPECTRAL DATA OF NEOFLAVONES



1. Apetatolide*

Calophyllum apetalum [6, 7], *C. inophyllum* [8]
$C_{26}H_{24}O_5$, **mp** 203-205°C [7]
UV [7]: 236 (4.55), 275 (4.40)
Mass [7]: 416, 401, 361
PMR (60 MHz, $CDCl_3$) [7]: 1.38 (6H, s), 1.92 (3H, d, J = 7), 1.95 (3H, s), 3.03 (3H, s), 5.67 (1H, d, J = 10), 6.05 (1H, s), 6.50 (1H, d, J = 10), 6.60 (1H, m)
Biol: antitumor activity [9]

*refined structure [5]

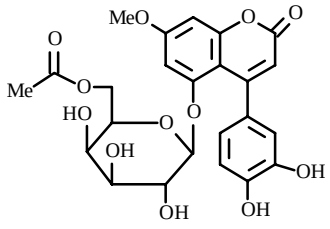


2. 5-O-[β-D-Apiofuranosyl-(1→6)-β-D-glucopyranosyl]-7,3′,4′-trihydroxy-4-phenylcoumarin

Coutarea hexandra [10]
$C_{26}H_{28}O_{15}$
Mass [10]: 579 $[M - H]^+$, 447, 285
PMR (250 MHz, CD_3OD) [10]: 2.62 (1H, dd, J = 7.5, J = 7.5, G-2″), 3.90 (1H, d, J = 2, A-2″), 4.72 (1H, d, J = 7.5, G-1″), 4.93 (1H, d, J = 2, A-1″), 5.84 (1H, s, H-3), 6.45 (1H, d, J = 2, H-8), 6.50 (1H, d, J = 2, H-6), 6.69 (1H, dd, J = 2, J = 7.5, H-6′), 6.80 (1H, d, J = 7.5, H-5′), 6.80 (1H, d, J = 2, H-2′).

^{13}C NMR (69.5 MHz, CD_3OD) [10]:

C-2	163.5	C-8a	157.3	G-1″	101.6	A-1″	111.0
3	112.3	1′	133.2	2″	74.6	2″	77.2
4	158.3	2′	116.9	3″	78.1	3″	80.5
4a	105.1	3′	145.5	4″	71.4	4″	75.1
5	158.1	4′	146.9	5″	77.7	5″	66.0
6	98.7	5′	115.9	6″	68.6		
7	163.3	6′	120.7				
8	101.1						

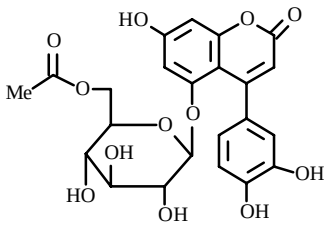


3. 5-O-(6″-Acetyl)-β-D-galactopyranosyl-3′,4′-dihydroxy-7-methoxy-4-phenylcoumarin

Exostema caribaeum [11], *Hintonia latiflora* [12]
$C_{24}H_{24}O_{12}$, **mp** 215-220°C [11]
UV (MeOH) [11]: 218, 258, 328
IR (KBr) [11]: 3467, 3409, 3395, 2918, 1730, 1695, 1536, 1614, 1442, 1355, 1258, 1072, 1047.
PMR (80 MHz, DMSO-d_6) [11]: 1.96 (3H, s, CH_3CO), 2.90-3.6 (6H, m, H-2″, H-3″, H-4″, H-5″, H-6″), 3.75 (3H, s, 7-OMe), 4.63 (1H, d, J = 8, H-1″), 5.76 (1H, s, H-3), 6.5-6.8 (5H, m, H-6, H-8, H-2′, H-5′, H-6′

^{13}**C NMR** (50 MHz, DMSO-d_6) [11]:

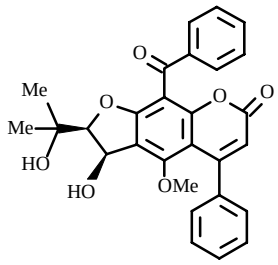
C-2	159.46	C-7	162.66	C-4′	145.75	C-4″	68.22
3	112.28	8	95.05	5′	115.54	C-5″	72.81
4	156.37	8a	155.67	6′	119.17	C-6″	63.52
4a	103.50	1′	130.44	1″	100.80	OMe-7	55.8
5	155.36	2′	114.76	2″	70.06	CH_3CO	20.35
6	98.94	3′	144.13	3″	72.66	CH_3CO	170.12



4. 5-O-(6″-Acetyl-*β*-D-glucopyranosyl)-7,3′,4′-trihydroxy-4-phenylcoumarin

Hintonia latiflora [13]
$C_{23}H_{22}O_{12}$, **mp** 205-208°C [13]
$[\alpha]_D$ -129° (MeOH) [13]
UV (MeOH) [13]: 258, 331
IR (KBr) [13]: 3440, 1701, 1618, 1602, 1384, 1368, 1215, 1083
PMR (300 MHz, DMSO-d_6) [13]: 2.00 (3H, s, MeCO), 2.60 (1H, dd, J = 8, H-2″), 3.02 (1H, dd, J = 8, H-4″), 3.18 (1H, dd, J = 8, H-3″), 3.41 (1H, dd, J = 8.3, H-5″), 4.05 (1H, m, H-6″), 4.68 (1H, d, J = 8, H-1″), 5.58 (1H, s, H-3), 6.25 (1H, d, J = 2.3, H-8), 6.32 (1H, d, J = 2.3, H-8), 6.58-6.80 (3H, m, H-2′, H-5′, H-6′)
^{13}**C NMR** (75 MHz, DMSO-d_6) [13]:

C-2	160.0	C-7	165.0	C-4′	144.2	C-4″	69.6
3	109.3	8	97.4	5′	114.5	C-5″	73.8
4	155.9	8a	156.1	6′	119.2	C-6″	63.2
4a	100.0	1′	130.8	1″	100.2	OMe-7	55.8
5	156.8	2′	115.6	2″	72.9	Ac	20.6
6	99.8	3′	145.7	3″	76.0	Ac	170.4



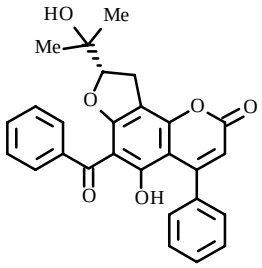
5. 9-Benzoyl-6-hydroxy-5-methoxy-4-phenylnodakenetin

Calophyllum teysmannii var. *inophyllolide* [14]
$C_{28}H_{24}O_7$, **mp** 206-208°C [14]
$[\alpha]_D$ -8.4° ($CHCl_3$) [14]
UV (EtOH) [14]: 254, 294, 328
IR (KBr) [14]: 3420, 1740, 1609, 1563, 1470, 1382, 1274, 1123, 1015, 965, 706, 656
Mass [14]: 472 (5) $[M]^+$, 454 (4), 439 (4), 397 (100), 368 (50), 319 (40)
HREIMS [14]: 472.1514 $[M]^+$
PMR (300 MHz, $CDCl_3$) [14]: 1.27 (3H, s, CH_3-13), 1.48 (3H, s, CH_3-12), 3.60 (3H, s, CH_3O-5), 4.28 (1H, d, J = 6.1, H-7), 5.55 (1H, d, J = 6.1, H-6), 6.00 (1H, s, H-3), 7.30 (2H, m, H-2′, H-6′), 7.41 (3H, m, H-3′, H-4′, H-5′), 7.47 (2H, t, J = 8.0, H-3″, H-5″), 7.60 (1H, tt, J = 8.0, J = 1.2, H-4″), 7.89 (2H, dd, J = 8.0, J = 1.2, H-2″, H-6″)
NOE, HMQC, HMBC [14]

^{13}C NMR (75 MHz, $CDCl_3$) [14]:

C-2	159.1	C-7	90.3	C-13	28.3	C-1″	137.6
3	113.5	8a	161.6	1′	139.8	2″	129.7
4*	155.2	9**	106.2	2′	126.9	3″	128.6
4a**	106.0	9a*	155.6	3′	128.0	4″	133.8
5	156.6	10	190.9	4′	127.6	5″	128.6
5a	115.9	11	72.8	5′	128.0	6″	129.7
6	71.2	12	24.7	6′	126.9	OMe-7	59.4

*,**Assignments may be reversed



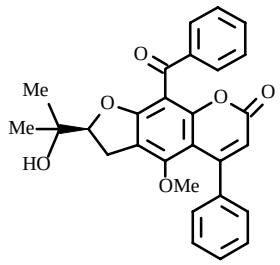
6. (-)-6-Benzoyl-5-hydroxy-4-phenylcolumbianelin

Calophyllum teysmannii var. *inophyllolide* [14]
$C_{27}H_{22}O_6$
$[\alpha]_D$ -80.5° ($CHCl_3$) [14]
UV (EtOH) [14]: 238, 296, 348
IR (KBr) [14]: 3446, 1745, 1617, 1540, 1470, 1389, 1123, 918, 698
Mass [14]: 442 (30) $[M]^+$, 424 (20), 409 (24), 383 (100)
HREIMS [14]: 442.1423 $[M]^+$

PMR (300 MHz, $CDCl_3$) [14]: 0.94 (3H, s, CH_3-13), 1.10 (3H, s, CH_3-12), 3.17 (1H, dd, J = 9.1, J = 15.5, CH_2-9b), 3.23 (1H, dd, J = 9.4, J = 15.5, CH_2-9a), 4.57 (1H, dd, J = 9.1, J = 9.4, H-8), 5.99 (1H, s, H-3), 7.37 (2H, m, H-2′, H-6′), 7.43 (5H, m, H-3′, H-4′, H-5′, H-3″, H-5″), 7.53 (3H, m, H-2″, H-4″, H-6″), 13.08 (1H, s, OH-5)
NOE, HMQC, HMBC [14]
^{13}C NMR (75 MHz, $CDCl_3$) [14]:

C-2	160.0	C-8	92.8	C-13	23.9	C-1″	140.4
3	112.4	9	27.0	1′	139.0	2″	127.6
4*	156.2	9a	105.8	2′	127.3	3″	127.7
4a	102.5	9b*	156.3	3′	128.0	4″	131.7
5**	163.5	10	199.1	4′	128.4	5″	127.7
6	102.9	11	71.3	5′	128.0	6″	127.6
6a**	163.7	12	23.9	6′	127.3		

*,** Assignments may be reversed



7. 9-Benzoyl-5-methoxy-4-phenylnodakenetin

Calophyllum teysmannii var. *inophyllolide* [14]
$C_{28}H_{24}O_6$, **mp** 208-210°C [14]
$[\alpha]_D$ -18.1° ($CHCl_3$) [14]
UV (EtOH) [14]: 224, 252, 292, 336
IR (KBr) [14]: 3450, 1733, 1602, 1563, 1470, 1389, 1266, 1115, 953, 691
Mass [14]: 456 (5) $[M]^+$, 398 (100)
HREIMS [14]: 456.1551 $[M]^+$

PMR (300 MHz, $CDCl_3$) [14]: 1.13 (3H, s, CH_3-13), 1.14 (3H, s, CH_3-12), 3.23 (1H, dd, J = 9.4, J = 15.4, CH_2-6b), 3.30 (3H, s, CH_3O-5), 3.31 (1H, dd, J = 8.1, J = 15.5, CH_2-6a), 4.66 (1H, dd, J = 8.1, J = 9.4, H-7), 5.98 (1H, s, H-3), 7.30 (2H,

m, H-2′, H-6′), 7.40 (3H, m, H-3′, H-4′, H-5′), 7.47 (2H, t, J = 7.9, H-3″, H-5″), 7.59 (1H, tt, J = 7.9, J = 1.2, H-4″), 7.89 (2H, dd, J = 7.9, J = 1.2, H-2″, H-6″)

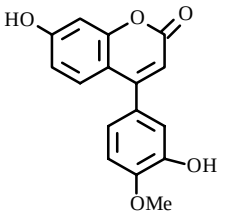
NOE, HMQC, HMBC [14]

X-ray [14]

^{13}C NMR (75 MHz, $CDCl_3$) [14]:

C-2	159.4	C-8a	161.8	C-13	24.5	C-1″	137.4
3	113.4	9	106.8	1′	139.5	2″	129.7
4*	155.2	9a	153.8	2′	127.0	3″	128.6
4a	106.4	10	190.8	3′	127.6	4″	133.8
5*	154.9	11	71.3	4′	128.4	5″	128.6
5a	114.4	11	71.4	5′	127.6	6″	129.7
6	28.3	12	25.6	6′	127.0	CH_3O-5	59.3
7	91.4						

*Assignments may be reversed



8. Volubolin

Dalbergia volubilis [15, 16]

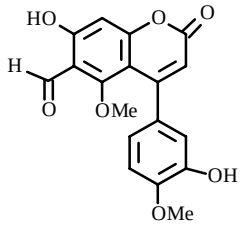
$C_{16}H_{12}O_5$

UV (MeOH) [16]: 224 (4.19), 284 (4.40), 340 (3.98)

IR (KBr) [16]: 3300, 1715, 1480, 1345, 1140, 1100, 1085, 1005, 935, 810

Mass [16]: 284 (21.9), 272 (40.0), 270 (21.2), 269 (26.8), 268 (89.4), 267 (13.6), 256 (25.6), 255 (14.4), 241 (14.1), 240 (41.6), 239 (12.1), 230 (17.8), 229 (17.3), 228 (45.6), 227 (18.1), 226 (18.4), 225 (54.9), 213 (33.5), 212 (41.0), 211 (38.4), 210 (90.2), 209 (24.7), 208 (16.0), 207 (30.5), 205 (13.6), 201 (26.0)

PMR (60 MHz, $CDCl_3$) [16]: 3.8 (3H, s, OMe), 5.93 (1H, s, H-3), 6.7 (3H, m, H-5, H-6, H-8), 7.2 (3H, m, H-2′, H-5′, H-6′), 9.85 (1H, s, OH), 10.3 (1H, s, OH)



9. Voludal

Dalbergia volubilis [16, 17]

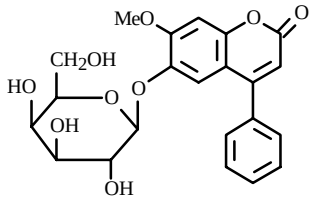
$C_{18}H_{14}O_7$

UV (MeOH) [16]: 220 (4.16), 288 (4.8), 343 (3.9)

IR (KBr) [16]: 3300, 3010, 2755, 1715, 1690, 1625, 1605, 1585, 1545, 1460, 1390, 1240, 1150

Mass [16]: 343 (2.9), 342 (17.9), 314 (3.3), 313 (9.1), 286 (3.0), 285 (4.3), 284 (7.4), 281 (2.7), 270 (8.1), 269 (4.0), 268 (12.1), 267 (2.7), 257 (3.0), 256 (12.1), 255 (3.3), 250 (2.7)

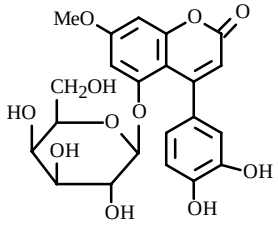
PMR (60 MHz, $CDCl_3$) [16]: 3.8 (3H, s, OMe), 4.0 (3H, s, OMe), 5.95 (1H, s, H-3), 7.3 (3H, m, H-2′, H-5′, H-6′), 7.5 (1H, s, H-8), 9.72 (1H, s, CHO), 9.85 (1H, s, OH), 10.2 (1H, s, OH)



10. 6-O-β-D-Galactopyranosyldalbergin

Hesperethusa crenulata [18]

$C_{22}H_{22}O_9$

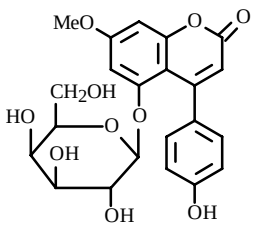


11. 5-O-β-D-Galactopyranosyl-3′,4′-dihydroxy-7-methoxy-4-phenylcoumarin

Exostema caribaeum [19], *Hintonia latiflora* [12]
$C_{22}H_{22}O_{11}$, **mp** 228-231°C [19]
UV (MeOH) [19]: 208, 255, 330
IR (KBr) [19]: 3650, 3403, 1719, 1613, 1160, 1078, 1049
PMR (80 MHz, C_5H_5N-d_6) [19]: 3.50 (4H, s, OH), 3.67 (3H, s, 7-OMe), 4.0-4.5 (6H, m, H-2″, H-3″, H-4″, H-5″, H-6″), 5.26 (1H, d, J = 8, H-1″), 6.20 (1H, s, H-3), 6.57 (1H, d, J = 3, H-8), 6.92 (1H, dd, J = 8, J = 3, H-6′), 7.08 (1H, d, J = 3, H-6), 7.20 (1H, d, J = 8, H-5′), 7.38 (1H, d, J = 3, H-2′)
^{13}C NMR (50 MHz, DMSO-d_6) [19]:

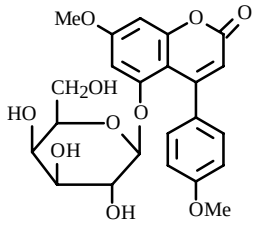
C-2	159.52	C-7	162.70	C-4′	145.71	C-3″	73.00
3	112.20	8	95.22	5′	115.51	4″	68.10
4	156.30	8a	156.00	6′	119.30	5″	75.90
4a	103.30	1′	130.44	1″	101.12	6″	60.43
5	155.44	2′	114.70	2″	70.13	OMe-7	55.90
6	98.50	3′	144.10				

Biol: antimicrobial activity against *Candida albicans* at MIC 12.5 µg/mL [11]



12. 5-O-β-D-Galactopyranosyl-4′-hydroxy-7-methoxy-4-phenylcoumarin

Hintonia latiflora [12]
$C_{22}H_{22}O_{10}$, **mp** 218-221°C [12]
IR (KBr) [12]: 3460, 3330, 1720, 1675, 1615, 1515, 1485, 1440, 1280, 970
PMR (90 MHz, DMSO-d_6) [12]: 3-4.40 (6H, m, H-2″—H-6″), 3.83 (3H, s, 7-OMe), 4.60 (1H, d, J = 7, H-1″), 5.78 (1H, s, H-3), 6.58 (1H, d, J = 3, H-8), 6.65 (1H, d, J = 3, H-6), 6.73 (2H, d, J = 8, H-3′, H-5′), 7.16 (2H, d, J = 8, H-2′, H-6′), 9.5 (1H, s, 4′-OH)

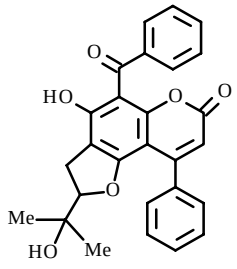


13. 5-O-β-D-Galactopyranosyl-7,4′-dimethoxy-4-phenylcoumarin

Exostema caribaeum [11]
$C_{23}H_{24}O_{10}$, **mp** 217-221°C [11]
UV (MeOH) [11]: 212, 236
IR (KBr) [11]: 3500, 3200, 1690, 1671, 1614, 1593, 1512, 1444, 1367, 1252, 1205, 1120, 1068, 831
PMR (80 MHz, DMSO-d_6) [11]: 3.84 (6H, s, OMe-7, OMe-4′), 3.0-4.03 (6H, m, H-2″—H-6″), 4.54 (1H, d, J = 8, H-1″), 5.92 (1H, s, H-3), 6.53 (1H, d, J = 3, H-6), 6.62 (1H, d, J = 3, H-8), 6.87 (2H, d, J = 8, H-3′, H-5′), 7.20 (2H, d, J = 8, H-2′, H-6′)

^{13}C NMR (50 MHz, DMSO-d_6) [11]:

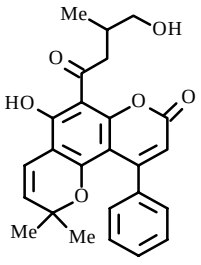
C-2	160.00	C-7	162.69	C-4′	157.60	C-3″	73.30
3	112.31	8	95.14	5′	114.20	4″	68.05
4	156.35	8a	155.97	6′	129.37	5″	75.85
4a	103.26	1′	129.80	1″	100.90	6″	60.46
5	155.54	2′	129.37	2″	69.78	OMe-7	55.91
6	98.36	3′	114.20			OMe-4′	55.91



14. Hydrohydroxyisocalanone

Calophyllum teysmannii var. *inophylloide* [20]
UV [20]: 236, 256, 318
IR [20]: 3454, 3061, 2925, 2854, 1739, 1603, 1446, 1382, 1283, 1140, 854, 768, 698, 606
Mass [20]: 442 (42) $[M]^+$, 424 (6), 409 (30), 383 (83), 105 (100), 77 (77)
HREIMS [20]: 442.1427 $[M]^+$
PMR (500 MHz, $CDCl_3$) [20]: 0.96 (3H, s, CH_3-12), 1.05 (3H, s, CH_3-13), 3.01 (1H, dd, J = 8.8, J = 15.5, H-7b), 3.14 (1H, dd, J = 9.8, J = 15.5, H-7a), 4.56 (1H, dd, J = 8.8, J = 9.8, H-6), 5.97 (1H, s, H-3), 7.33 (2H, m, H-2′, H-6′), 7.44 (3H, m, H-3′, H-4′, H-5′), 7.49 (2H, t, J = 8.0, H-3″, H-5″), 7.59 (1H, dd, J = 8.0, J = 1.5, H-4″), 7.66 (2H, dd, J = 8.0, J = 1.5, H-2″, H-6″), 12.18 (1H, s, OH)
HMQC, HMBC [20]
^{13}C NMR (125 MHz, $CDCl_3$) [20]:

C-2	158.2	C-7a	110.0	C-13	24.9	C-1″	140.3
3	111.9	8	161.6	1′	137.9	2″	128.2
4	154.2	9	104.8	2′	127.6	3″	128.2
4a	98.9	9a	156.4	3′	128.9	4″	132.4
4b	162.1	10	198.9	4′	127.9	5″	128.2
6	92.8	11	71.6	5′	128.9	6″	128.2
7	26.9	12	23.1	6′	127.6		

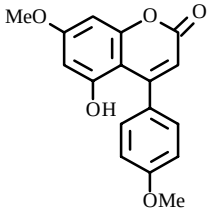


15. 7-Hydroxy-8-(4-hydroxy-3-methyl-1-oxobutyl)-4-phenyl-2′,2′-dimethyl-2*H*,6*H*-benzo[1,2-b:3,4-b′]-dipyran-2-one

Kielmeyera reticulata [21]
$C_{25}H_{24}O_6$
$[\alpha]_D$ -1.92° ($CHCl_3$) [21]
Mass [21]: 402 (30) $[M - H_2O]^+$, 388 (28), 387 (100), 359 (6), 331 (16)
PMR (300 MHz, $CDCl_3$) [21]: 0.95 (3H, s, CH_3-6′), 0.97 (3H, s, CH_3-5′), 1.01 (3H, d, J = 6.7, CH_3-5″), 1.83 (1H, s, OH-4′), 2.50 (1H, m, H-3″), 2.71 (1H, dd, J = 9.1, J = 13.9, H-2a″), 3.42 (1H, dd, J = 9.0, J = 10.5, H-4b″), 3.79 (1H, dd, J = 5.0, J = 10.5, H-4a″), 3.82 (1H, dd, J = 4.3, J = 13.9, H-2b″), 5.40 (1H, d, J = 10.1, H-3′), 6.02 (1H, s, H-3), 6.62 (2H, d, J = 10.1, H-4′), 7.22 (2H, m, Ph-4), 7.40 (3H, m, Ph-4), 14.67 (1H, s, OH-7)
^{1}H-^{13}C COSY [21]

^{13}C NMR (75 MHz, $CDCl_3$) [21]:

C-2	160.1	C-8	104.7	C-6′	28.0	C-1‴	140.4
3	112.2	8a	157.2	1″	206.7	2‴	127.6
4	157.3	2′	79.8	2″	49.4	3‴	128.2
4a	102.8	3′	127.4	3″	34.0	4‴	128.4
5	157.2	4′	115.8	4″	68.7	5‴	128.2
6	106.5	5′	28.0	5″	17.0	6‴	127.6
7	164.6						



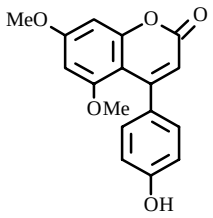
16. 5-Hydroxy-7,4′-dimethoxy-4-phenylcoumarin

Exostema acuminatum [22]
$C_{17}H_{14}O_5$, **mp** 210-212°C [22], 212°C [23]
UV (MeOH) [23]: 223, 261, 326

^{13}C NMR (125.7 MHz, $CDCl_3$) [22]:

C-2	161.1	C-6	95.9	C-1′	132.4	C-5′	114.3
3	112.6	7	163.3	2′	128.9	6′	128.9
4	157.3	8	96.6	3′	114.3	OMe	55.8
4a	103.7	8a	155.5	4′	158.3	OMe	55.4
5	155.6						

Biol: cytotoxic activity against cell lines BC1, Lu1, Col2, KB, KB-V^+, KB-V^-, LNCaP, SW626, SKNSH, and M109 [22]



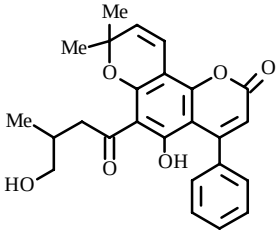
17. 4′-Hydroxy-5,7-dimethoxy-4-phenylcoumarin

Coutarea hexandra [24, 25], *Exostema mexicanum* [26]
$C_{17}H_{14}O_5$, **mp** 214-215°C [24]
UV (MeOH) [27]: 254 (4.09), 322 (4.05); **UV** (MeOH+MeONa): 254, 328, 372
IR (KBr) [27]: 3300, 1706, 1612, 1159, 1048, 962, 835
Mass [24]: 298 (100) $[M]^+$, 270 (82), 255 (29), 227 (15)

PMR [200 MHz, $(CD_3)_2CO$] [27]: 3.56 (3H, s, OMe-5), 3.96 (3H, s, OMe-7), 5.84 (1H, s, H-3), 6.40 (1H, d, J = 2.5, H-6), 6.56 (1H, d, J = 2.5, H-8), 6.92 (2H, d, J = 8.5, H-3′, H-5′), 7.16 (2H, d, J = 8.5, H-2′, H-6′), 8.56 (1H, s, OH-4′)
^{13}C NMR (100 MHz, DMSO-d_6) [28]:

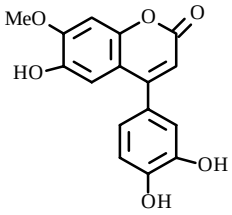
C-2	159.4	C-6	95.7	C-1′	129.6	C-5′	113.9
3	111.2	7	162.8	2′	128.6	6′	128.6
4	155.1	8	93.6	3′	113.9	OMe	55.5
4a	102.6	8a	156.4	4′	157.3	OMe	55.7
5	157.9						

Biol: antiplasmodial activity against *Plasmodium falciparum* [26]



18. Hydroxymammeigin

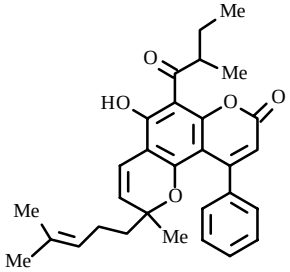
Kielmeyera elata [29]
$C_{25}H_{24}O_6$, **mp** 174-176°C [29]
UV (MeOH) [29]: 232 (4.53), 284 (4.60), 335 (3.94); (MeOH+NaOH): 252 (4.45), 308 (4.48), 405 (3.78); (MeOH+NaOAc): 232 (4.48), 286 (4.51), 336 (4.07)
IR (KBr) [29]: 3440, 1740, 1720, 1600, 1590, 1380, 1260, 1125, 780, 750, 700
Mass [29]: 420 (2) $[M]^+$, 402 (65), 387 (100), 359 (5), 334 (12), 331 (16), 303 (4), 165 (5), 77 (5)
PMR (400 MHz, $CDCl_3$) [29]: 0.98 (3H, d, J = 6.8, H-5″), 1.57 (6H, s, H-5′, H-6′), 2.35 (1H, m, H-3″), 3.05 (1H, dd, J = 16.4, J = 6.6, H-2a″), 3.20 (1H, dd, J = 16.4, J = 6.9, H-2b″), 3.50 (1H, dd, J = 10.4, J = 6.3, H-4a″), 3.57 (1H, dd, J = 10.6, J = 5.3, H-4b″), 5.62 (1H, d, J = 10.1, H-2′), 5.98 (1H, s, H-3), 6.88 (1H, d, J = 10.1, H-1′), 7.30-7.38 (5H, m, Ph-4), 14.55 (1H, s, OH-5)



19. 3′-Hydroxymelanetin

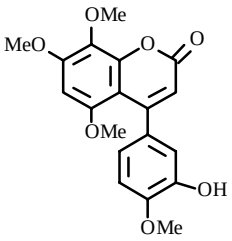
Dalbergia odorifera [30, 31]
$C_{16}H_{12}O_6$, **mp** 297-299°C [30]
UV (MeOH) [30]: 235 (4.274), 256 (4.063), 296 (3.934), 346 (4.179)
Mass [30]: 300 (76) $[M]^+$, 272 (68), 257 (63), 187 (12), 155 (16), 136 (14), 127 (15), 115 (36), 114 (18), 113 (27), 102 (14), 87 (16), 77 (34), 69 (100), 63 (41), 53 (36), 51 (35)
HRMS [30]: 300.0633
PMR (300 MHz, DMSO-d_6) [30]: 3.87 (3H, s, OMe-7), 6.05 (1H, s, H-3), 6.79 (1H, dd, J = 8, J = 1.8, H-6′), 6.86 (1H, d, J = 1.8, H-2′), 6.88 (1H, d, J = 8, H-5′), 6.98 (1H, s, H-5), 7.07 (1H, s, H-8), 9.39 (1H, s, OH-3′), 9.43 (1H, s, OH-6), 9.52 (1H, s, OH-4′)
NOESY, HMQC, HMBC [30]
^{13}C NMR (75.4 MHz, DMSO-d_6) [30]:

C-2	160.99	C-6	143.79	C-10	111.49	C-4′	147.41
3	110.59	7	152.12	1′	126.68	5′	120.26
4	155.72	8	100.89	2′	145.81	6′	116.08
5	111.11	9	148.83	3′	116.26	7-OMe	56.55



20. 5-Hydroxy-2-methyl-6-(2-methylbutanoyl)-2-(4-methyl-3-pentenyl)-10-phenyl-2*H*,8*H*-pyrano[2,3-*f*]chromen-8-one

Mesua ferrea [32]
$C_{30}H_{32}O_5$



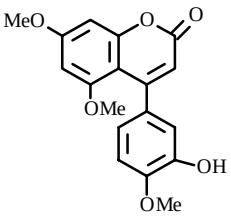
21. 3′-Hydroxy-5,7,8,4′-tetramethoxy-4-phenylcoumarin

Coutarea hexandra [33]
$C_{19}H_{18}O_7$, **mp** 161-162°C [33]
UV (MeOH) [33]: 263 (4.18), 324 (4.09)
IR ($CDCl_3$) [33]: 3540, 1718, 1610, 1595, 1513, 1348, 1280, 1244, 1109, 1060, 862
Mass [33]: 358 (100) $[M]^+$, 343 (43), 330 (3), 315 (18), 287 (14), 179 (3), 165 (2)
PMR [300 MHz, $(CD_3)_2CO$] [33]: 3.56 (3H, s, 5-OMe), 3.83 (3H, s, 8-OMe), 3.90 (3H, s, 4′-OMe), 3.99 (3H, s, 7-OMe), 5.87 (1H, s, H-3), 6.64 (1H, s, H-6), 6.79 (1H, dd, J = 8.2, J = 2, H-6′), 6.87 (1H, d, J = 2, H-2′), 6.98 (1H, d, J = 8.2, H-5′), 7.75 (1H, s, 3′-OH)
^{13}C NMR (75 MHz, DMSO-d_6) [33]:

C-2	159.3	C-6	94.0	C-2′	114.9	8-OMe	60.7
3*	111.5	7**	155.3	3′	145.5	OMe	56.3
4**	155.7	8	129.8	4′	147.7	OMe	56.1
4a	102.8	8a	144.6	5′*	111.2	OMe	55.6
5	153.6	1′	132.0	6′	129.8		

*,** Assignments may be reversed

Biol: adenosine-3′,5′-cyclomonophosphate-phosphodiesterase inhibitor at IC_{50} 12.5×10^{-5} M [34]

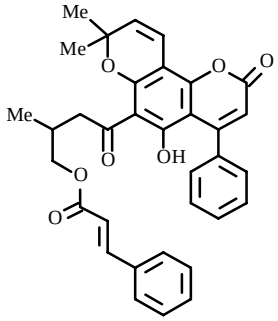


22. 3′-Hydroxy-5,7,4′-trimethoxy-4-phenylcoumarin

Coutarea hexandra [24], *Exostema acuminatum* [22], *E. mexicanum* [26]
$C_{18}H_{16}O_6$, **mp** 153-154°C [24, 27]
UV (MeOH) [24]: 252 (4.13), 329 (4.32)
IR ($CHCl_3$) [24]: 3525, 1710, 1615, 1597, 1510, 1158, 1111, 1052, 945, 909, 859, 828
Mass [24]: 328 (100) $[M]^+$, 300 (51), 285 (31), 257 (15)
PMR ($CDCl_3$) [24]: 3.42 (3H, s), 3.78 (3H, s), 3.86 (3H, s), 5.87 (1H, s), 5.92 (1H, s), 6.6-6.9 (4H, m)
^{13}C NMR (125.7 MHz, DMSO-d_6) [22]:

C-2	161.0	C-6	95.9	C-2′	114.2	C-6′	119.1
3	109.6	7	163.6	3′	144.6	OMe	56.0
4	157.2	8	93.6	4′	146.6	OMe	55.7
4a	103.6	8a	155.4	5′	112.6	OMe	55.6
5	160.0	1′	133.1				

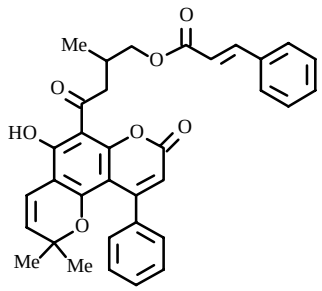
Biol: cytotoxic activity against cell lines BC1, Lu1, Col2, KB-V^+, KB-V^-, SW626, SKNSH, and M109 [2]; antiplasmodial activity against *Plasmodium falciparum* [26]



23. 5-Hyhdroxy-6-(4-cinnamoyl-3-methyl-1-oxobutyl)-4-phenyl-2′,2′-dimethyl-2*H*,6*H*-benzo[1,2-*b*:3,4-*b*′]-dipyran-2-one

Kielmeyera reticulata [21], *K. argentea* [35]
$C_{34}H_{30}O_7$
$[\alpha]_D$ -6.6° ($CHCl_3$) [21]
Mass [21]: 550 (7) $[M]^+$, 402 (31), 388 (19), 387 (82), 347 (10), 331 (28), 147 (52), 131 (100), 103 (56)
PMR (300 MHz, $CDCl_3$) [21]: 1.06 (3H, d, J = 6.7, CH_3-5″), 1.55 (3H, s, CH_3-6′), 1.57 (3H, s, CH_3-5′), 2.65 (1H, m, H-3″), 3.05 (1H, dd, J = 7.3, H = 17.0, H-2a″), 3.25 (1H, dd, J = 6.1, J = 17.0, H-2b″), 4.16 (2H, d, J = 6.1, CH_2-4″), 5.64 (1H, d, J = 10.1, H-3′), 5.96 (1H, s, H-3), 6.38 (1H, d, J = 16.0, H-2C), 6.88 (1H, d, J = 10.1, H-4′), 7.26 (2H, m, Ph-4), 7.38 (6H, m, Ph-4, cinnamoyl), 7.46 (2H, m, cinnamoyl), 7.62 (1H, d, J = 16.0, H-3C), 14.65 (1H, s, OH-5)
^{1}H-^{13}C COSY [21]
^{13}C NMR (75 MHz, $CDCl_3$) [21]:

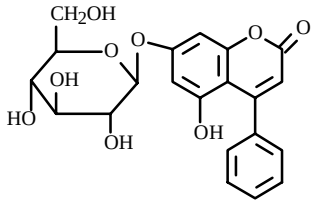
C-2	159.9	C-2′	80.7	C-5″	17.8	C-2C	118.4
3	113.4	3′	127.0	1‴	139.8	3C	145.5
4	156.8	4′	116.1	2‴	127.6	4C	134.9
4a	102.8	5′	28.8	3‴	128.2	5C	128.6
5	164.8	6′	28.7	4‴	128.8	6C	129.5
6	107.9	1″	206.0	5‴	128.2	7C	130.9
7	155.5	2″	49.1	6‴	127.6	8C	129.5
8	102.2	3″	30.0	1C	167.3	9C	128.6
8a	158.7	4″	69.3				



24. 7-Hydroxy-8-(4-cinnamoyl-3-methyl-1-oxobutyl)-4-phenyl-2′,2′-dimethyl-2*H*,6*H*-benzo[1,2- *b*:3,4-*b*′]-dipyran-2-one

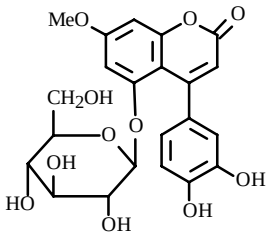
Kielmeyera reticulata [21], *K. argentea* [35]
$C_{34}H_{30}O_7$
$[\alpha]_D$ -7.14° ($CHCl_3$) [21]
Mass [21]: 550 (3) $[M]^+$, 535 (13), 402 (19), 388 (26), 387 (100), 331 (20), 148 (28), 147 (43), 131 (36), 103 (33)
PMR (300 MHz, $CDCl_3$) [21]: 0.92 (3H, s, CH_3-6′), 0.93 (3H, s, CH_3-5′), 1.18 (3H, d, J = 6.8, CH_3-5″), 2.71 (1H, m, H-3″), 3.28-3.48 (2H, m, CH_2-2″), 4.17-4.29 (2H, m, CH_2-4″), 5.37 (1H, d, J = 10.0, H-3′), 6.01 (1H, s, H-3), 6.41 (1H, d, J = 16.0, H-2C), 6.60 (1H, d, J = 10.0, H-4′), 7.22 (2H, m, Ph-4), 7.37 (6H, m, Ph-4, cinnamoyl), 7.52 (2H, m, cinnamoyl), 7.64 (1H, d, J = 16.0, H-3C), 14.45 (1H, s, OH-7)
^{13}C NMR (75 MHz, $CDCl_3$) [21]:

C-2	159.2	C-2′	79.7	C-5″	17.9	C-2C	118.6
3	112.6	3′	127.3	1‴	140.5	3C	145.2
4	156.5	4′	115.8	2‴	127.7	4C	135.1
4a	102.9	5′	28.0	3‴	128.1	5C	128.7
5	157.0	6′	28.0	4‴	128.3	6C	129.3
6	106.4	1″	205.4	5‴	128.1	7C	130.7
7	164.0	2″	49.3	6‴	127.7	8C	129.3
8	104.8	3″	30.8	1C	167.4	9C	128.7
8a	157.0	4″	69.4				



25. Serratin 7-β-glucoside

Passiflora serratodigitata [36]
$C_{21}H_{20}O_9$, **mp** 166-168°C [36]
UV (MeOH) [36]: 208 (5.0), 248, 258 (4.1), 328 (3.9)
IR (KBr) [36]: 3400, 1700, 1615, 1600, 1585, 1550, 1495, 1450, 1355, 1280, 1220, 1170, 1090, 1065, 1030, 940, 820, 700
PMR (90 MHz, DMSO-d_6) [36]: 3.1-3.7 (6H, m, Glu), 5.0 (1H, d, J = 6, H-1 Glu), 5.8 (1H, s, H-3), 6.25 (1H, d, J = 2, H-8), 6.3 (1H, d, J = 2, H-6), 7.52 (5H, s, Ph-4)

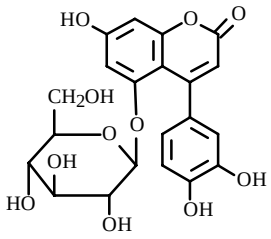


26. 5-O-(β-D-Glucopyranosyl)-3′,4′-dihydroxy-7-methoxy-4-phenylcoumarin

Hintonia latiflora [12], *Coutarea hexandra* [10], *Exostema caribaeum* [11], *E. mexicanum* [37]
$C_{22}H_{22}O_{11}$, **mp** 237-238°C [11]
UV (MeOH) [11]: 218, 259, 329
IR (KBr) [11]: 3500, 2900, 1700, 1618, 1430, 1360, 1310, 1230, 1090, 1040
Mass [10]: 461 [M - H]$^-$, 299
PMR (250 MHz, CD_3OD) [10]: 2.62 (1H, dd, J = 7.5, J = 7.5, G-2″), 3.85 (3H, s, OMe), 5.90 (1H, s, H-3), 6.60 (1H, d, J = 2, H-8), 6.65 (1H, d, J = 2, H-6), 6.70 (1H, dd, J = 2, J = 7.5, H-6′), 6.81 (1H, d, J = 7.5, H-5′), 6.81 (1H, d, J = 2, H-2′)
^{13}C NMR (69.5 MHz, CD_3OH) [10]:

C-2	163.0	C-7	165.0	C-4′	147.0	C-3″	78.3
3	113.2	8	100.0	5′	115.9	4″	71.2
4	158.0	8a	157.2	6′	120.6	5″	77.7
4a	105.5	1′	132.9	1″	101.5	6″	62.5
5	158.0	2′	117.0	2″	74.6	OMe-7	56.5
6	96.7	3′	145.5				

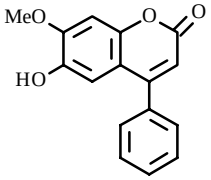
Biol: inhibits ATP synthesis, proton absorption, and energy transfer in chloroplasts [38, 39]



27. 5-O-(β-D-Glucopyranosyl)-7,3′,4′-trihydroxy-4-phenylcoumarin

Hintonia latiflora [12], *Coutarea hexandra* [10]
$C_{21}H_{20}O_{11}$, **mp** 250-252°C [12]
Mass [10]: 447 [M - H]$^-$, 285
PMR (250 MHz, CD_3OD) [10]: 2.62 (1H, dd, J = 7.5, J = 7.5, G-2″), 4.80 (1H, d, J = 7.5, G-1″), 5.83 (1H, s, H-3), 6.43 (1H, d, J = 2, H-8), 6.51 (1H, d, J = 2, H-6), 6.69 (1H, dd, J = 2, J = 7.5, H-6′), 6.79 (1H, d, J = 7.5, H-5′), 6.80 (1H, d, J = 2, H-2′)
^{13}C NMR (69.5 MHz, CD_3OD) [10]:

C-2	163.6	C-7	163.2	C-3′	145.5	G-1″	101.4
3	112.3	8	101.1	4′	146.9	2″	74.6
4	158.3	8a	157.3	5′	115.9	3″	78.2
4a	104.5	1′	133.1	6′	120.5	4″	71.1
5	158.1	2′	117.1			5″	77.7
6	98.1					6″	62.5



28. Dalbergin

Dalbergia sissoo [40, 41], *D. latifolia* [42], *D. melanoxylon* [43], *D. nigra* [44], *D. miscolobium* [45], *D. sissoides* [46], *D. cearensis* [47], *D. nitidula* [48], *D. riparia* [49], *D. spinosa* [50], *D. coromandeliana* [51], *D. baroni* [52, 53], *D. volubilis* [15, 16], *D. stevensonii* [54], *D. odorifera* [30, 31], *D. cultrata* [55], *Machaerium kuhlmannii* [56], *M. nictitans* [56], *M. scleroxylon* [57], *M. pedicellatum* [58], *Piptadenia macrocarpa* [59], *Prosopis kuntzei* [60], *Goniorrhachis marginata* [61], *Cassia alata* [62]

$C_{16}H_{12}O_4$, **mp** 209°C [63], 209-210°C [40], 210-211°C [30], 211-212°C [16], 214-216°C [54]

UV (MeOH) [16]: 235, 280, 380; (EtOH+NaOH) [63]: 260, 318

IR (KBr) [16]: 3200, 1700, 1610, 1500, 1450

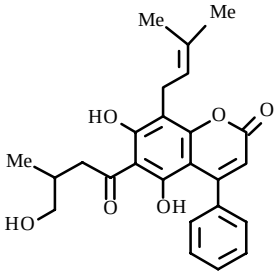
Mass [63]: 268 (100) $[M]^+$, 240, 225, 197, 168, 155, 141, 127

PMR (200 MHz, DMSO-d_6) [30]: 3.86 (3H, s, 7-OMe), 6.16 (1H, s, H-3), 6.79 (1H, s, H-5), 7.08 (1H, s, H-8), 7.52 (5H, m, Ph-4), 9.43 (1H, s, OH-6)

NOESY, HMQC, HMBC [30]

^{13}C NMR (75.4 MHz, DMSO-d_6) [30]:

C-2	160.85	C-6	143.96	C-10	111.32	C-4′	129.95
3	111.70	7	152.35	1′	135.72	5′	128.24
4	155.55	8	100.91	2′	128.71	6′	128.71
5	110.75	9	148.83	3′	128.24	OMe	56.57



29. 5,7-Dihydroxy-6-(4-hydroxy-3-methyl-1-oxobutyl)-8-(3-methyl-2-butenyl)-4-phenyl-2*H*-1-benzopyran-2-one

Kielmeyera reticulata [21]

$C_{25}H_{26}O_6$

$[\alpha]_D$ +1.58° ($CHCl_3$) [21]

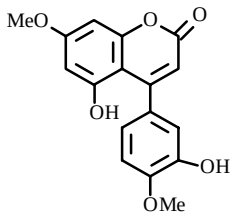
Mass [21]: 404 (20) $[M - H_2O]^+$, 389 (15), 361 (100), 349 (30), 327 (6)

PMR (300 MHz, $CDCl_3$) [21]: 0.99 (H, d, J = 6.6, CH_3-5″), 1.63 (3H, s, CH_3-6′), 1.69 (3H, s, CH_3-5′), 2.48 (1H, m, H-3″), 2.73 (1H, dd, J = 8.8, J = 14.0, H-2a″), 3.28 (2H, d, J = 7.6, CH_2-4′), 3.41 (1H, dd, J = 8.8, J = 11.3, H-2b″), 3.75 (2H, m, CH_2-4″), 5.07 (1H, d, J = 6.0, H-3′), 5.90 (1H, s, H-3), 7.40 (2H, m, Ph-4), 7.54 (5H, m, Ph-4), 14.61 (1H, s, OH-7)

^{1}H-^{13}C COSY [21]

^{13}C NMR (75 MHz, $CDCl_3$) [21]:

C-2	160.0	C-8	113.4	C-1″	206.6	C-1‴	137.5
3	112.4	8a	158.0	2″	49.4	2‴	128.0
4	155.5	2′	134.6	3″	33.7	3‴	130.0
4a	101.3	3′	121.3	4″	68.5	4‴	130.7
5	156.4	4′	22.1	5″	17.0	5‴	130.0
6	105.6	5′	17.0			6‴	128.0
7	167.6	6′	26.2				

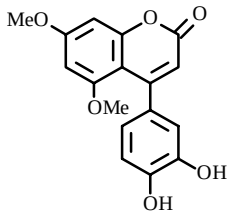


30. 5,3′-Dihydroxy-7,4′-dimethoxy-4-phenylcoumarin

Exostema caribaeum [11], *Ex. acuminatum* [22]
$C_{17}H_{14}O_6$, **mp** 225-226°C [11, 22]
UV (MeOH) [11]: 196, 252, 328
IR (KBr) [11]: 3460, 1690, 1620, 1515, 1440, 1370, 1350, 1335, 1285, 1200, 1050, 835, 810
Mass [11]: 314 (100), 286 (64.8), 271 (37.7)
PMR (80 MHz, $CDCl_3$) [11]: 3.83 (3H, s, 7-OMe), 3.98 (3H, s, 4′-OMe), 5.95 (1H, s, H-3), 6.28 (1H, d, J = 3, H-6), 6.51 (1H, d, J = 3, H-8), 6.97-6.99 (3H, m, H-2′, H-5′, H-6′)
^{13}C NMR (125.7 MHz, DMSO-d_6) [22]:

C-2	163.0	C-6	94.9	C-1′	132.3	C-5′	115.3
3	104.8	7	152.9	2′	115.3	6′	130.0
4	159.0	8	129.4	3′	143.9	OMe	56.9
4a	112.5	8a	145.1	4′	152.3	OMe	56.7
5	158.8						

Biol: cytotoxic activity against cell lines BC1, Lu1, Col2, KB, KB-V^+, KB-V^-, LNCaP, SW626, SKNSH, and M109 [22]

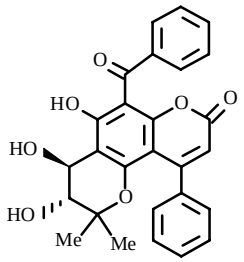


31. 3′,4′-Dihydroxy-5,7-dimethoxy-4-phenylcoumarin

Coutarea hexandra [24, 64], *Exostema mexicanum* [26]
$C_{17}H_{14}O_6$, **mp** 211-212°C [24, 64]
UV (MeOH) [24]: 253, 326, 438
IR ($CDCl_3$) [24]: 3600, 3540, 3260, 1707, 1611, 1595, 1513, 1158, 1111, 1052, 945, 910, 872, 858, 828
Mass [24]: 314 (100) $[M]^+$, 296 (98), 271 (20), 243 (4)
PMR [$(CD_3)_2CO$] [24]: 3.55 (3H, s), 3.92 (3H, s), 5.85 (1H, s), 6.38 (1H, d, J = 2.5), 6.53 (1H, d, J = 2.5), 6.68-6.98 (3H, m)
^{13}C NMR (100 MHz, DMSO-d_6) [28]:

C-2	159.7	C-6	95.8	C-1′	129.6	C-5′	114.6
3	111.3	7	163.0	2′	115.1	6′	118.8
4	155.5	8	93.7	3′	144.2	OMe	55.6
4a	103.0	8a	156.7	4′	145.6	OMe	55.7
5	158.2						

Biol: inhibitor of adenosine-3′,5′-cyclomonophosphate-phosphodiesterase at IC_{50} 11.7×10^{-5} M [34], antiplasmodial activity against *Plasmodium falciparum* [26]

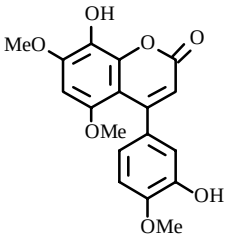


32. *trans*-7,8-Dihydroxycalanone

Calophyllum teysmannii var. *inophyllolide* [14]
$C_{27}H_{22}O_7$
$[\alpha]_D$ -31.2° ($CHCl_3$) [14]
UV (EtOH) [14]: 252, 324
IR (KBr) [14]: 3431, 1722, 1652, 1540, 1455, 1131

Mass [14]: 440 (100) $[M - 18]^+$, 412 (20), 397 (30), 368 (50), 319 (40)
PMR [300 MHz, $(CD_3)_2CO$] [14]: 0.84 (3H, s, CH_3-13), 1.02 (3H, s, CH_3-12), 3.57 (1H, d, J = 7.7, H-7), 4.84 (1H, d, J = 7.7, H-8), 5.78 (1H, s, H-3), 7.33 (2H, m, H-2′, H-6′), 7.43 (3H, m, H-3′, H-4′, H-5′), 7.51 (2H, t, J = 7.4, H-3″, H-5″), 7.63 (1H, tt, J = 7.4, J = 1.0, H-4″), 7.88 (2H, dd, J = 7.4, J = 1.0, H-2″, H-6″), 12.88 (1H, s, OH-9)
NOE, HMQC, HMBC [14]
^{13}C NMR [75 MHz, $(CD_3)_2CO$] [14]:

C-2	158.6	C-8a	106.4	C-1′	140.6	C-1″	138.5
3	111.7	9	156.6	2′	127.2	2″	129.2
4	152.3	10	108.6	3′	127.6	3″	128.6
4a	102.5	10a	154.1	4′	127.2	4″	133.2
4b	155.9	11	193.1	5′	127.6	5″	128.6
6	80.2	12	18.6	6′	127.2	6″	129.2
7	74.0	13	24.8				
8	68.5						

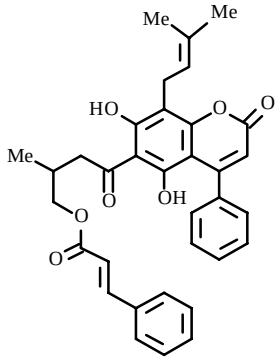


33. 8,3′-Dihydroxy-5,7,4′-trimethoxy-4-phenylcoumarin

Coutarea hexandra [33], *Exostema acuminatum* [22]
$C_{18}H_{16}O_7$, **mp** 191-192°C [33]
UV (MeOH) [33]: 271 (4.19), 324 (4.10); (MeOH+MeONa): 286, 332, 384
IR ($CDCl_3$) [33]: 3545, 1712, 1610, 1590, 1512, 1176, 1112, 1050, 860
Mass [33]: 344 (100) $[M]^+$, 329 (10), 316 (25), 301 (25), 297 (25), 273 (13), 269 (23)
PMR [300 MHz, $(CD_3)_2CO$] [33]: 3.51 (3H, s, 5-OMe), 3.90 (3H, s, 4′-OMe), 3.97 (3H, s, 7-OMe), 5.85 (1H, s, H-3), 6.65 (1H, s, H-6), 6.79 (1H, dd, J = 8.2, J = 2, H-6′), 6.83 (1H, d, J = 2, H-2′), 6.98 (1H, d, J = 8.2, H-5′), 7.73 (1H, s, OH), 7.82 (1H, s, OH)
^{13}C NMR (75 MHz, DMSO-d_6) [33]:

C-2	160.6	C-6	94.5	C-1′	133.6	C-5′*	111.4
3*	111.7	7**	151.9	2′	115.3	6′	119.1
4	145.6	8	128.1	3′	143.9	OMe	58.6
4a	103.3	8a**	150.8	4′	148.2	OMe	56.1
5	156.2						

*,**Assignments may be reversed
Biol: cytotoxic activity against cell lines BC1, Lu1, Col2, KB, KB-V^+, KB-V^-, LNCaP, SW626, SKNSH, and M109 [22]



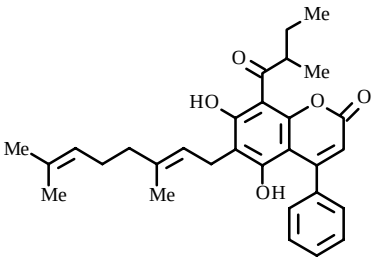
34. 5,7-Dihydroxy-6-(4-cinnamoyl-3-methyl-1-oxobutyl)-8-(3-methyl-2-butenyl)-4-phenyl-2*H*-1-benzopyran-2-one

Kielmeyera reticulata [21]
$C_{34}H_{32}O_7$
$[\alpha]_D$ -12.17° ($CHCl_3$) [21]
Mass [21]: 404 (38) $[M - C_6H_5C_2H_2COOH]^+$, 389 (11), 361 (38), 349 (21), 321 (9), 131 (100)
PMR (300 MHz, $CDCl_3$) [21]: 1.18 (1H, d, J = 6.0, CH_3-5″), 1.64 (3H, s, CH_3-6′), 1.69 (3H, s, CH_3-5′), 2.71 (1H, m, H-3″), 3.27 (2H, d, J = 8.0,

CH_2-4′), 3.31 (1H, dd, J = 6.0, J = 15.0, H-2a″), 3.45 (1H, dd, J = 6.0, J = 15.0, H-2b″), 4.24 (2H, m, CH_2-4″), 5.06 (1H, d, J = 6.0, H-3′), 5.97 (1H, s, OH-5), 6.00 (1H, s, H-3), 6.41 (1H, d, J = 16.0, H-2C), 7.39 (5H, m, Ph-4, cinnamoyl), 7.52 (5H, m, Ph-4, cinnamoyl), 7.66 (1H, d, J = 16.0, H-3C), 14.39 (1H, s, OH-7)

^{13}C NMR (75 MHz, $CDCl_3$) [21]:

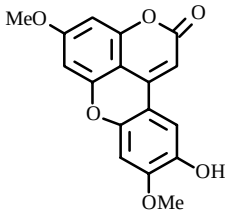
C-2	158.9	C-2′	134.7	C-1‴	137.4	C-1C	167.1
3	112.8	3′	121.3	2‴	128.0	2C	118.7
4	154.6	4′	22.1	3‴	130.1	3C	145.2
4a	101.1	5′	17.9	4‴	130.7	4C	135.1
5	156.5	6′	26.2	5‴	130.1	5C	128.6
6	105.2	1″	205.5	6‴	128.0	6C	129.4
7	167.4	2″	49.3			7C	130.8
8	113.2	3″	30.7			8C	129.4
8a	157.9	4′	69.4			9C	128.6
		5″	18.4				



35. 6-(3,7-Dimethyl-2,6-octadienyl)-5,7-dihydroxy-8-(2-methylbutanoyl)-4-phenylcoumarin

Mesua ferrea [32]

$C_{30}H_{34}O_5$



36. 7,4′-Dimethoxy-5′-hydroxy-4-phenyl-5,2′-oxidocoumarin

Exostema caribaeum [19]

$C_{17}H_{12}O_7$, **mp** 273-274°C [19]

UV (MeOH) [19]: 262, 308, 372, 388

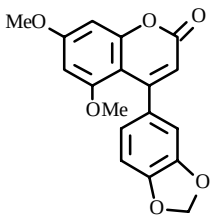
IR (KBr) [19]: 3400, 3330, 3175, 3160, 1677, 1618, 1523, 1458, 1289, 1205, 1169, 1120, 817

Mass [19]: 312 (100), 284 (30.1), 269 (10), 256 (51.1)

PMR (80 MHz, C_5H_5N-d_6) [19]: 3.86 (3H, s, 7-OMe), 3.90 (3H, s, 4′-OMe), 5.91 (1H, s, H-3), 6.60 (2H, s, H-6, H-8), 6.90 (1H, s, H-3′), 7.20 (1H, s, H-6′)

^{13}C NMR (50 MHz, DMSO-d_6) [19]:

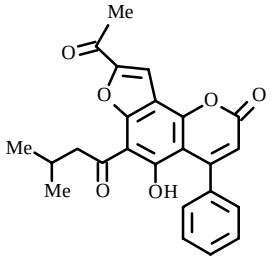
C-2	160.90	C-6	96.41	C-1′	107.14	C-5′	141.00
3	100.51	7	163.02	2′	146.32	6′	108.70
4	153.70	8	93.12	3′	96.00	7-OMe	56.14
4a	99.80	8a	154.50	4′	144.31	4′-MeO	56.14
5	150.49						



37. 5,7-Dimethoxy-3′,4′-methylenedioxy-4-phenylcoumarin

Countarea hexandra [65]
$C_{18}H_{14}O_6$, **mp** 194-195°C [65]
UV (MeOH) [65]: 248 (4.07), 327 (4.42)
IR ($CDCl_3$) [65]: 1710, 1613, 1595, 1505, 1157, 1110, 1052, 1039, 938, 904, 858, 810
Mass [65]: 326 (81) $[M]^+$, 298 (100), 289 (13), 255 (4)
PMR (60 MHz, $CDCl_3$) [65]: 3.47 (s, 3H), 3.83 (s, 3H), 5.93 (s, 1H), 5.95 (s, 2H), 6.19 (d, J = 2.5, 1H), 6.46 (d, J = 2.5, 1H), 6.75-6.85 (m, 3H)
^{13}C NMR (100 MHz, DMSO-d_6) [28]:

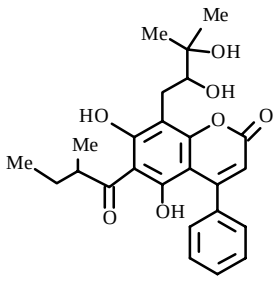
C-2	159.2	C-6	95.9	C-1′	132.8	C-5′	107.3
3	111.6	7	163.0	2′	107.8	6′	120.5
4	154.4	8	93.8	3′	146.8	OMe	55.6
4a	102.8	8a	156.3	4′	146.2	OCH_2O	100.8
5	157.9						



38. Disparacetylfuran A

Calophyllum dispar [66]
$C_{24}H_{20}O_6$
UV (EtOH) [66]: 289 (3.87), 363 (3.34), 434 (2.72); (EtOH+NaOH): 252 (3.73), 286 (3.66), 374 (3.71), 432 (3.56)
IR ($CHCl_3$) [66]: 3460, 1717, 1684, 1625, 758, 701
HRFABMS [66]: 403.1186 $[M - H]^-$
PMR (270 MHz, $CDCl_3$) [66]: 1.07 (6H, d, J = 6.5, CH_3-4″, CH_3-5″), 2.29 (1H, m, CH-3″), 2.63 (1H, s, CH_3-5‴), 3.18 (2H, d, J = 6.5, CH_2-2″), 6.22 (1H, s, 1H, H-3), 7.37 (2H, m, H-2′, H-6′), 7.45 (3H, m, H-3′, H-4′, H-5′), 7.83 (1H, s, H-3‴), 15.05 (1H, s, OH-5)
HMBC, HMQC [66]
^{13}C NMR (67.5 MHz, $CDCl_3$) [66]:

C-2	158.5	C-8	110.0	C-4′	128.6	C-4″	22.6
3	115.0	9	156.5	5′	127.8	5″	22.6
4	156.4	10	103.4	6′	127.2	2‴	152.3
5	165.9	1′	138.4	1″	204.4	3‴	111.2
6	119.0	2′	127.2	2″	51.8	4‴	186.1
7	147.0	3′	127.8	3″	25.5	5‴	26.4

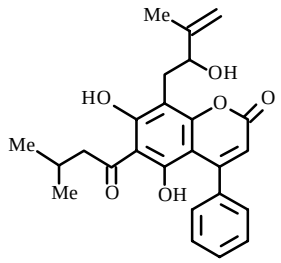


39. Dispardiol B

Calophyllum dispar [67]
$C_{25}H_{28}O_7$
UV (EtOH) [67]: 234 (4.22), 284 (4.43), 355 (3.93), 426 (3.59); (EtOH+NaOH): 238 (4.29), 279 (4.31), 381 (4.06), 410 (4.05)
IR ($CHCl_3$) [67]: 3460, 1717, 1706, 1617, 768, 702
HRLSIMS [67]: 441.1927 $[M + H]^+$
HMBC [67]

PMR (500 MHz, $CDCl_3$) [67]: 0.90 (3H, t, J = 7.5, CH_3-5″), 1.15 (3H, d, J = 6.5, CH_3-3″), 1.36 (1H, s, CH_3-4‴), 1.40 (1H, m, CH_2-4a″), 1.49 (1H, s, CH_3-5‴), 1.80 (1H, m, CH_2-4b″), 2.61 (1H, dd, J = 10.0, J = 15.0, CH_2-1a‴), 3.37 (1H, d, J = 15.0, CH_2-1b‴), 3.74 (1H, dd, J = 7.0, J = 8.0, H-2‴), 3.84 (1H, m, H-2″), 5.97 (1H, s, H-3), 7.32 (2H, m, H-2′, H-6′), 7.41 (3H, m, H-3′, H-4′, H-5′), 10.26 (1H, s, OH-7), 14.29 (1H, s, OH-5)
^{13}C NMR (125 MHz, $CDCl_3$) [67]:

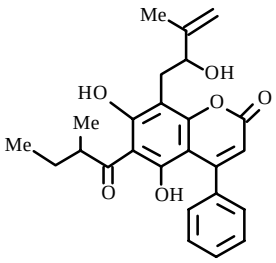
C-2	159.7	C-8	105.3	C-5′	127.6	C-5″	11.8
3	111.9	8a	157.3	6′	127.1	1‴	26.0
4	156.6	1′	139.1	1″	212.1	2‴	80.6
4a	101.9	2′	127.1	2″	46.5	3‴	73.2
5	163.5	3′	127.6	3″	16.5	4‴	26.7
6	107.6	4′	128.2	4″	26.7	5‴	22.2
7	162.4						



40. Disparinol A

Calophyllum dispar [68]
$C_{25}H_{26}O_6$, **mp** 115-116°C [68]
UV (EtOH+HCl) [68]: 242 (4.09), 284 (4.42), 341 (4.00); (EtOH+NaOH): 244 (4.21), 302 (4.21), 381 (4.05), 412 (4.07)
IR [68]: 1700, 1622, 1580, 1559, 756, 697
Mass [68]: 422 (4), 404 (8), 389 (5), 352 (84), 351 (100), 347 (9), 333 (21), 295 (14)
HREIMS [68]: 422.1726 $[M]^+$
PMR (270 MHz, $CDCl_3$) [68]: 0.94 (6H, dd, J = 2.0, J = 6.5, CH_3-5‴), 1.93 (3H, s, CH_3-5″), 2.23 (1H, m, CH-4″), 3.02 (2H, d, J = 6.5, CH_2-2″), 3.04 (1H, dd, J = 8.0, J = 15.5, CH_2-1a‴), 3.32 (1H, dd, J = 2.0, J = 15.0, CH_2-1b‴), 4.50 (1H, d, J = 7.5, H-2‴), 4.94 (1H, s, CH_2-4a‴), 5.03 (1H, s, CH_2-4b‴), 5.96 (1H, s, H-3), 7.33 (2H, m, H-2′, H-6′), 7.42 (3H, m, H-3′, H-4′, H-5′), 10.18 (1H, s, OH-7), 14.43 (1H, s, OH-5)
DQF-COSY, HMBC [68]
^{13}C NMR (67.5 MHz, $CDCl_3$) [68]:

C-2	160.0	C-7	162.5	C-4′	128.2	C-5″	22.7
3	112.1	8	104.7	5′	127.7	1‴	28.8
4	156.7	8a	157.7	6′	127.1	2‴	77.5
4a	102.0	1′	139.3	1″	207.5	3‴	146.0
5	163.3	2′	127.1	2″	53.5	4‴	111.1
6	107.8	3′	127.7	4″	25.1	5‴	18.7



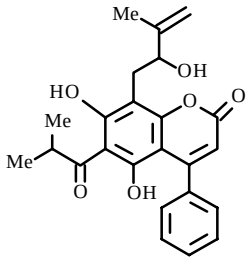
41. Disparinol B

Calophyllum dispar [68]
$C_{25}H_{26}O_6$
UV (EtOH+HCl) [68]: 235 (4.00), 284 (4.24), 340 (3.82); (EtOH+NaOH): 243 (4.09), 302 (4.07), 382 (3.92), 409 (3.93)
IR [68]: 3420, 1718, 1618, 1584, 758, 702
Mass [68]: 422 (6), 404 (17), 378 (53), 363 (37), 352 (53), 351 (82), 347 (58), 333 (32), 321 (100), 295 (30)
HREIMS [68]: 422.1747 $[M]^+$

PMR (270 MHz, $CDCl_3$) [68]: 0.90 (3H, t, J = 7.0, CH_3-5″), 1.14 (3H, d, J = 6.5, CH_3-3″), 1.39 (1H, m, CH_2-4a″), 1.79 (1H, m, CH_2-4b″), 1.94 (3H, s, CH_3-5‴), 3.06 (1H, dd, J = 7.5, J = 15.0, CH_2-1a‴), 3.30 (1H, dd, J = 2.0, J = 15.0, CH_2-1b‴), 3.84 (1H, m, H-2″), 4.51 (1H, d, J = 6.0, H-2‴), 4.93 (1H, s, CH_2-4a‴), 5.02 (1H, s, CH_2-4b‴), 5.97 (1H, s, H-3), 7.33 (2H, m, H-2′, H-6′), 7.41 (3H, m, H-3′, H-4′, H-5′), 10.20 (1H, s, OH-7), 14.33 (1H, s, OH-5)
DQF-COSY, HMQC, HMBC [68]
^{13}C NMR (67.5 MHz, $CDCl_3$) [68]:

C-2	159.9	C-8	104.7	C-5′	127.7	C-5″	11.9
3	112.2	8a	157.7	6′	127.2	1‴	28.7
4	156.7	1′	139.4	1″	212.2	2‴	77.7
4a	102.1	2′	127.2	2″	46.6	3‴	146.0
5	163.4	3′	127.7	3″	16.4	4‴	111.1
6	107.4	4′	128.2	4″	26.8	5‴	18.8
7	162.1						

Biol: cytotoxic activity against cell line KB at ED_{50} 7 µg/mL [67]

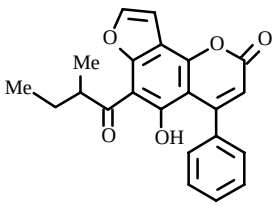


42. Disparinol D

Calophyllum dispar [67]
$C_{24}H_{24}O_6$
UV (EtOH) [67]: 235 (3.75), 283 (3.89), 331 (3.46); (EtOH+NaOH): 258 (3.82), 306 (3.75), 391 (3.42), 409 (3.41)
IR ($CHCl_3$) [67]: 3420, 1732, 1716, 1622, 1595, 756, 702
HRFABMS [67]: 407.1530 $[M - H]^-$
PMR (500 MHz, $CDCl_3$) [67]: 1.16 (6H, d, J = 7.0, CH_3-3″, CH_3-4″), 1.95 (3H, s, CH_3-5‴), 3.05 (1H, dd, J = 8.0, J = 15.5, CH_2-1a‴), 3.13 (1H, d, J = 7.0, H-2″), 3.32 (1H, dd, J = 2.0, J = 15.0, CH_2-1b‴), 4.51 (1H, d, J = 7.5, H-2‴), 4.94 (1H, s, CH_2-4b‴), 5.03 (1H, s, CH_2-4a‴), 5.97 (1H, s, H-3), 7.33 (2H, m, H-2′, H-6′), 7.42 (3H, m, H-3′, H-4′, H-5′), 10.20 (1H, s, OH-7), 14.29 (1H, s, OH-5)
HMBC [67]
^{13}C NMR (125 MHz, $CDCl_3$) [67]:

C-2	159.9	C-7	162.1	C-4′	128.2	C-4″	19.2
3	112.2	8	104.7	5′	127.7	1‴	28.7
4	156.6	8a	157.7	6′	127.1	2‴	77.7
4a	102.1	1′	139.4	1″	212.3	3‴	146.0
5	163.4	2′	127.1	2″	39.9	4‴	111.1
6	106.9	3′	127.7	3″	19.2	5‴	18.7

Biol: cytotoxic activity against cell line KB at ED_{50} 21 µg/mL [67]

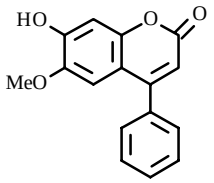


43. Disparfuran B

Calophyllum dispar [66]
$C_{22}H_{18}O_5$
UV (EtOH) [66]: 238 (3.78), 283 (4.00), 330 (3.54); (EtOH+NaOH): 255 (3.78), 282 (3.76), 314 (3.70), 419 (3.46)
IR ($CHCl_3$) [66]: 3440, 1732, 1717, 1622, 1559, 756, 700
HRAPCIMS [66]: 363.1248 $[M + H]^+$

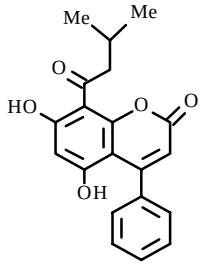
PMR (270 MHz, $CDCl_3$) [66]: 0.97 (3H, t, J = 7.5, CH_3-5″), 1.24 (3H, d, J = 6.5, CH_3-3″), 1.55 (1H, m, CH_2-4″β), 1.86 (1H, m, CH_2-4″α), 3.83 (1H, m, H-2″), 6.17 (1H, s, H-3), 7.17 (1H, d, J = 2.0, H-3‴), 7.37 (2H, m, H-2′, H-6′), 7.43 (3H, m, H-3′, H-4′, H-5′), 7.66 (1H, d, J = 2.0, H-2‴), 14.79 (1H, s, OH-5)
DQF-COSY, HMBC, NOESY [66]
^{13}C NMR (67.5 MHz, $CDCl_3$) [66]:

C-2	159.4	C-8	109.8	C-4′	128.4	C-3″	16.3
3	114.3	9	153.4	5′	127.7	4″	26.5
4	156.8	10	103.3	6′	127.1	5″	11.8
5	163.5	1′	138.9	1″	208.6	2‴	143.8
6	104.9	2′	127.1	2″	45.7	3‴	104.7
7	155.8	3′	127.7				



44. Isodalbergin

Dalbergia sissoo [69]
$C_{16}H_{12}O_4$, **mp** 195-196°C [69]



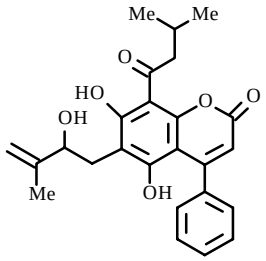
45. Isodispar B

Calophyllum dispar [67]
$C_{20}H_{17}O_5$
UV (EtOH) [67]: 222 (4.40), 292 (4.32), 329 (4.25); (EtOH+NaOH): 225 (4.34), 253 (4.21), 333 (4.45), 381 (3.93), 428 (4.01)
IR ($CHCl_3$) [67]: 3500, 1684, 1622, 1594, 774, 700
HRFABMS [67]: 337.1174 $[M - H]^-$

PMR (500 MHz, $CDCl_3$) [67]: 1.06 (6H, d, J = 6.5, CH_3-4″, CH_3-5″), 2.31 (1H, m, H-3″), 3.19 (2H, d, J = 6.5, CH_2-2″), 6.02 (1H, s, H-3), 6.26 (1H, s, H-6), 7.43 (m, 2H, H-2′, H-6′), 7.56 (m, 3H, H-3′, H-4′, H-5′), 14.77 (s, 1H, OH-7)
^{13}C NMR (125 MHz, $CDCl_3$) [67]:

C-2	158.5	C-6	101.4	C-2′	127.4	C-1″	205.8
3	111.7	7	168.8	3′	129.6	2″	53.5
4	154.0	8	104.9	4′	130.4	3″	25.5
4a	100.8	8a	155.7	5′	129.6	4″	22.6
5	159.6	1′	136.3	6′	127.4	5″	22.6

Biol: cytotoxic activity against cell line KB at ED_{50} 8 µg/mL [67]

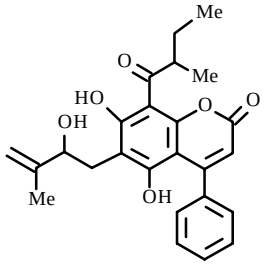


46. Isodisparinol A

Calophyllum dispar [68]
$C_{25}H_{26}O_6$
UV (EtOH+HCl) [68]: 226 (4.38), 292 (4.32), 328 (4.10); (EtOH+NaOH): 230 (4.29), 263 (4.08), 336 (4.39)
IR [68]: 3407, 1717, 1620, 1597, 1559, 758, 702
Mass [68]: 422 (6), 404 (12), 389 (6), 352 (57), 351 (100), 347 (9), 333 (30), 305 (10), 295 (15)
HREIMS [68]: 422.1726 $[M]^+$
PMR (270 MHz, $CDCl_3$) [68]: 1.06 (6H, d, J = 7.0, CH_3-5‴), 1.81 (3H, s, CH_3-5″), 2.32 (1H, m, CH-4‴), 2.77 (1H, dd, J = 8.0, J = 15.0, CH_2-1a″), 3.13 (1H, dd, J = 2.0, J = 15.0, CH_2-1b″), 3.20 (1H, dd, J = 1.5, J = 6.5, H-2‴), 4.32 (1H, d, J = 8.0, H-2″), 4.86 (1H, s, CH_2-4a″), 4.93 (1H, s, CH_2-4b″), 6.03 (1H, s, H-3), 7.32 (2H, m, H-2′, H-6′), 7.41 (3H, m, H-3′, H-4′, H-5′), 9.29 (1H, s, OH-5), 14.80 (1H, s, OH-7)
HMBC [68]
^{13}C NMR (67.5 MHz, $CDCl_3$) [68]:

C-2	159.1	C-7	166.9	C-4′	128.2	C-4″	110.6
3	112.2	8	104.1	5′	127.8	1‴	18.4
4*	156.4	8a*	156.5	6′	127.1	2‴	206.1
4a	102.2	1′	139.8	1″	28.6	3‴	53.5
5	160.3	2′	127.1	2″	76.8	4‴	25.7
6	109.8	3′	127.8	3″	146.4	5‴	22.7

*Assignments may be reversed

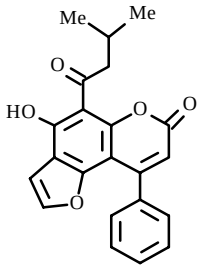


47. Isodisparinol B

Calophyllum dispar [68]
$C_{25}H_{26}O_6$
UV (EtOH+HCl) [68]: 228 (4.21), 289 (4.04), 328 (3.71); (EtOH+NaOH): 229 (3.96), 262 (3.69), 335 (4.03)
IR [68]: 3431, 1700, 1605, 771, 694
HRLSIMS [68]: 423.1808 $[M + H]^+$
PMR (270 MHz, $CDCl_3$) [68]: 1.03 (3H, t, J = 7.5, CH_3-5‴), 1.29 (3H, dd, J = 8.0, J = 6.5, CH_3-3‴), 1.53 (1H, m, CH_2-4a‴), 1.82 (3H, s, CH_3-5″), 1.95 (1H, m, CH_2-4b‴), 2.78 (1H, dd, J = 8.5, J = 15.0, CH_2-1a″), 3.12 (1H, dd, J = 2.0, J = 15.0, CH_2-1b″), 3.99 (1H, m, CH_2-2‴), 4.32 (1H, d, J = 8.0, H-2″), 4.87 (1H, s, CH_2-4a″), 4.94 (1H, s, CH_2-4b″), 6.04 (1H, s, H-3), 7.32 (2H, m, H-2′, H-6′), 7.41 (3H, m, H-3′, H-4′, H-5′), 9.22 (1H, s, OH-5), 14.80 (1H, s, OH-7)
HMBC [68]
^{13}C NMR (67.5 MHz, $CDCl_3$) [68]:

C-2	159.2	C-8	103.7	C-5′	127.8	C-5″	18.4
3	112.2	8a*	156.3	6′	127.1	1‴	210.6
4*	156.4	1′	139.8	1″	28.6	2‴	46.8
4a	102.2	2′	127.1	2″	76.8	3‴	27.2
5	160.2	3′	127.8	3″	146.4	4‴	22.7
6	109.9	4′	128.2	4″	110.6	5‴	11.8
7	167.0						

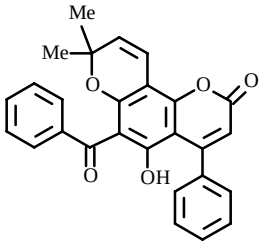
*Assignments may be reversed



48. Isodisparfuran A

Calophyllum dispar [66]
$C_{22}H_{18}O_5$
UV (EtOH) [66]: 230 (3.96), 253 (3.97), 287 (3.84), 337 (3.58); (EtOH+NaOH): 241 (4.01), 259 (3.90), 280 (3.79), 308 (3.58)
UR ($CHCl_3$) [66]: 3450, 2930, 1744, 1609, 756, 702
HREIMS [66]: 362.1170 $[M]^+$
PMR (270 MHz, $CDCl_3$) [66]: 1.09 (6H, d, J = 7.0, CH_3-4‴, CH_3-5‴), 2.37 (1H, m, H-3‴), 3.30 (2H, d, J = 7.0, CH_2-2‴), 6.22 (1H, s, H-3), 6.96 (1H, d, J = 2.0, H-3‴), 7.31 (1H, d, J = 2.0, H-2‴), 7.42 (2H, m, H-2′, H-6′), 7.50 (3H, m, H-3′, H-4′, H-5′), 14.84 (1H, s, OH-5)
DQF-COSY, HMBC, HMQC [66]
^{13}C NMR (67.5 MHz, $CDCl_3$) [66]:

C-2	159.2	C-8	106.1	C-4′	129.3	C-1‴	207.3
3	112.0	9	154.3	5′	128.1	2‴	53.6
4	153.7	10	100.0	6′	127.9	3‴	25.6
5	154.2	1′	137.1	2″	146.6	4‴	22.7
6	115.0	2′	127.9	3″	104.9	5‴	22.7
7	162.7	3′	128.1				

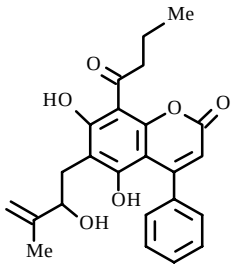


49. Isocalanone

Calophyllum teysmanii var. *inophyllolide* [14, 70]
$C_{27}H_{20}O_5$, **mp** 188-190°C [70]
UV (EtOH) [70]: 240 (3.70), 296 (3.67), 386 (2.90)
IR (KBr) [70]: 3430, 3068, 2363, 1729, 1597, 1420, 1260, 1188, 1145, 856, 748, 689, 575
Mass [70]: 424 (52), 409 (100), 331 (52), 303 (13), 105 (76), 77 (74)
HREIMS [70]: 424.13237
PMR (500 MHz, $CDCl_3$) [70]: 1.06 (6H, s, Me-12, Me-13), 5.48 (1H, d, J = 10.2, H-9), 6.02 (1H, s, H-3), 6.83 (1H, d, J = 10.2, H-10), 7.35-7.38 (2H, m), 7.39-7.42 (5H, m), 7.48-7.53 (3H, m, H-1′—H-6′, H-1″—H-6″), 12.54 (1H, s, OH-5)
HMBC [70]
X-ray [70, 71]
^{13}C NMR (125 MHz, $CDCl_3$) [70]:

C-2	159.6	C-8	79.5	C-13	27.9	C-1″	141.4
3	112.7	9	126.9	1′	139.0	2″	127.8
4	156.1	10	114.9	2′	127.3	3″	127.9
4a	102.0	10a	101.6	3′	127.6	4″	131.2
5	162.2	10b*	157.3	4′	128.5	5″	127.9
6	107.1	11	200.4	5′	127.6	6″	127.8
6a*	154.9	12	27.9	6′	127.3		

*Assignments may be reversed

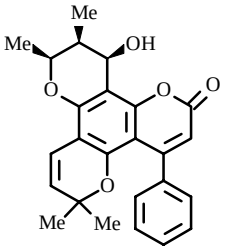


50. Isoracemosol

Mesua racemosa [72]
$C_{24}H_{24}O_6$
UV (EtOH+HCl) [72]: 225 (3.89), 292 (3.89), 326 (3.66); (EtOH+NaOH): 229 (4.03), 257 (3.88), 335 (4.03)
IR [72]: 3447, 1734, 1707, 1597, 1387, 1134, 771, 702
Mass [72]: 409 (55), 391 (66), 337 (72)
HRLSIMS [72]: 409.1647 $[M]^+$
PMR (270 MHz, $CDCl_3$) [72]: 1.07 (3H, t, J = 7.5, CH_3-4‴), 1.78 (2H, m, CH_2-3‴), 1.81 (3H, s, CH_3-5″), 2.78 (1H, dd, J = 2, J = 15, CH_2-1a″), 3.10 (1H, dd, J = 2, J = 15, CH_2-1b″), 3.34 (2H, t, J = 7.0, CH_2-2‴′), 4.32 (1H, d, J = 7.5, H-2″), 4.86 (1H, s, CH_2-4b″), 4.93 (1H, s, CH_2-4a″), 6.03 (1H, s, H-3), 7.30 (2H, m, H-2′, H-6′), 7.40 (3H, m, H-3′, H-4′, H-5′), 14.77 (1H, s, OH-7)
HMBC [72]
^{13}C NMR (67.5 MHz, $CDCl_3$) [72]:

C-2	159.3	C-7**	166.8	C-4′	128.2	C-4″	110.6
3	112.1	8	104.0	5′	127.8	5″	18.5
4*	156.6	8a*	156.4	6′	127.1	1‴	206.3
4a	102.2	1′	139.8	1″	28.5	2‴	46.6
5**	160.3	2′	127.1	2″	77.4	3‴	18.1
6	109.8	3′	127.8	3″	146.4	4‴	13.8

*,**Assignments may be reversed

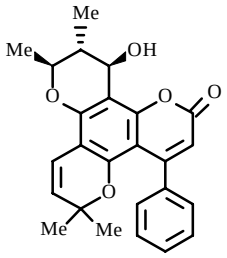


51. Inophyllum A [(+)-*cis*-dihydroinophyllolide]

Calophyllum inophyllum [73, 74], *C. moonii* [75]
$C_{25}H_{24}O_5$, **mp** 193-195°C [75], 200-201°C [73]
$[\alpha]_D$ +43° (acetone) [73, 76], +68.8° ($CHCl_3$) [75]
UV (EtOH) [75]: 235 (4.18), 280 (4.15), 286 (4.18), 337 (3.95)
IR (KBr) [75]: 3400, 2680-2820, 1710, 1635, 1590, 1445, 1380, 1350, 1150, 850, 770, 700
Mass [75]: 404 (25) $[M]^+$, 389 (100), 386 (1), 371 (4), 333 (50)
PMR ($CDCl_3$) [75]: 0.97 (3H, s, CH_3-10), 0.98 (3H, s, CH_3-10), 1.16 (3H, d, J = 7.2, CH_3-3), 1.43 (3H, d, J = 6.92, CH_3-2), 2.27 (1H, m, J = 5.19, J = 3.46, H-3), 4.43 (1H, m, J = 6.92, J = 3.46, H-2), 5.17 (1H, d, J = 5.19, H-4), 5.33 (1H, d, J = 9.9, H-11), 5.96 (1H, s, H-7), 6.51 (1H, d, J = 9.9, H-12), 7.30 (5H, m, Ph-8)
X-ray [76]
^{13}C NMR (100 MHz, $CDCl_3$) [74]:

C-2	160.3	C-8	115.9	C-12a	105.5	C-17	127.2
3	111.4	8a	106.3	12b	154.0	18	127.2
4	156.2	8b	152.5	13	139.9	19	26.7
4a	103.1	10	75.7	14	127.2	20	26.7
4b	150.9	11	35.5	15	127.2	21	16.0
6	76.8	12	62.6	16	127.5	22	9.7
7	127.1						

Biol: inhibitor of HIV-1 reverse transcriptase (RT) at IC_{50} 30 μM [74], antitumor activity [9]



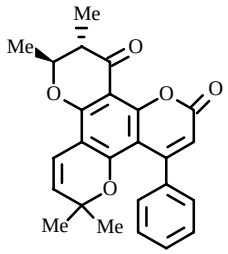
52. Inophyllum B [(+)-*trans*-dihydroinophyllolide]

Calophyllum inophyllum [73, 74, 77]
$C_{25}H_{24}O_5$, **mp** 200-202°C [73]
$[\alpha]_D$ +36° (acetone) [76]
UV (EtOH) [73]: 232 (4.23), 277 (4.15), 286 (4.2), 334 (3.96)
IR (mineral oil) [73]: 3430, 1717, 767, 703
Mass [73]: 404 $[M]^+$, 386, 371

PMR (400 MHz, $CDCl_3$) [74]: 0.91 (3H, s, CH_3-20), 0.97 (3H, s, CH_3-19), 1.18 (3H, d, J = 6.8, CH_3-22), 1.47 (3H, d, J = 6.4, CH_3-21), 1.97 (1H, ddq, J = 6.8, J = 9.1, J = 7.8, H-11), 3.96 (1H, dq, J = 6.4, J = 9.1, H-10), 4.79 (1H, d, J = 7.8, H-12), 5.37 (1H, d, J = 10.0, H-7), 5.97 (1H, s, H-3), 6.53 (1H, d, J = 10.0, H-8), 7.41, 7.31 (5H, m, Ph-4)
X-ray [76]
^{13}C NMR (100 MHz, $CDCl_3$) [74]:

C-2	160.6	C-8	116.0	C-12a	106.1	C-17	127.3
3	111.7	8a	106.0	12b	153.6	18	127.3
4	156.3	8b	153.7	13	140.0	19	26.9
4a	103.1	10	73.0	14	127.3	20	26.8
4b	151.1	11	38.2	15	127.3	21	18.8
6	76.7	12	61.8	16	127.6	22	12.5
7	127.1						

Biol: inhibitor of HIV-1 RT at IC_{50} 0.038 µM [74], activity against HIV-1 in cell culture at IC_{50} 1.4 µM [74]



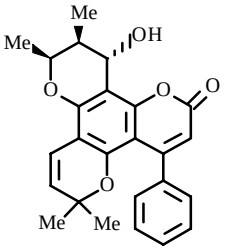
53. Inophyllum C [(+)-*trans*-inophyllolide]

Calophyllum inophyllum [73, 74, 77, 78], *C. teysmannii* var. *inophyllolide* [14, 79, 80]
$C_{25}H_{22}O_5$, **mp** 186-188°C [78], 188-191°C [73]
$[\alpha]_D$ +13° ($CHCl_3$) [73]
UV (EtOH) [73]; 240 (4.32), 257 (4.46), 266 (4.49), 302 (4.39)
IR (mineral oil) [73]: 1727, 1688, 767, 703

Mass [73]: 402 $[M]^+$, 387 (15), 331 (56), 303 (28)
PMR (60 MHz, $CDCl_3$) [73]: 0.95 (3H, s, CH_3-6), 0.98 (3H, s, CH_3-6), 1.24 (3H, d, J = 7.2, CH_3-11), 1.56 (3H, d, J = 6.6, CH_3-10), 2.59 (1H, m, J = 7.2, J = 11.5, H-11), 4.32 (1H, m, J = 6.6, J = 11.5, H-10), 5.42 (1H, d, J = 10.0, H-7), 6.04 (1H, s, H-3), 6.56 (1H, d, J = 10.0, H-8), 7.3 (5H, m, Ph-4)
^{13}C NMR (100 MHz, $CDCl_3$) [74]:

C-2	159.6	C-8	115.2	C-12a	103.9	C-17	127.5
3	113.5	8a	105.4	12b	154.9	18	127.5
4	159.4	8b	155.1	13	139.9	19	27.2
4a	103.4	10	79.7	14	127.5	20	27.4
4b	155.6	11	47.3	15	127.5	21	19.6
6	78.6	12	190.0	16	127.7	22	10.6
7	127.2						

Biol: inhibitor of HIV-1 RT at IC_{50} 10 µM [74], antitumor activity [9], cytotoxic activity against cell lines P388, WEHI164, THP-1, and MOLT4 [14]



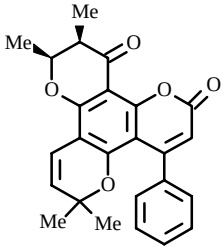
54. Inophyllum D

Calophyllum inophyllum [73, 74]
$C_{25}H_{24}O_5$, **mp** 200-202°C [73]
$[\alpha]_D$ +35° ($CDCl_3$) [76]
UV (EtOH) [73]: 232 (4.23), 277 (4.15), 286 (4.2), 334 (3.96)
IR (mineral oil) [73]: 3430, 1717, 767, 703
Mass [73]: 404 $[M]^+$, 386, 371

PMR (60 MHz, $CDCl_3$) [73]: 0.94 (6H, s, CH_3-6), 1.17 (3H, d, J = 7.2, CH_3-11), 1.43 (3H, d, J = 7.0, CH_3-10), 2.27 (1H, m, H-11), 4.43 (1H, m, J = 3.3, J = 7.0, H-10), 5.17 (1H, d, J = 5.4, H-12), 5.36 (1H, d, J = 10, H-7), 5.96 (1H, s, H-3), 6.55 (1H, d, J = 10, H-8), 7.3 (5H, m, Ph-4)
X-ray [76]
^{13}C NMR (100 MHz, $CDCl_3$) [74]:

C-2	160.7	C-8	115.9	C-12a	103.9	C-17	127.3
3	111.7	8a	106.0	12b	154.6	18	127.3
4	156.4	8b	153.9	13	139.9	19	26.9
4a	103.3	10	71.1	14	127.3	20	26.8
4b	151.0	11	37.2	15	127.3	21	17.5
6	77.1	12	64.5	16	127.5	22	9.1
7	127.1						

Biol: inhibitor of HIV-1 RT at IC_{50} 11 µM [9], antitumor activity [9]



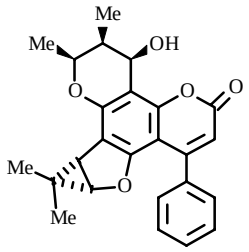
55. Inophyllum E [(+)-*cis*-inophyllolide]

Calophyllum inophyllum [73, 74, 77],
C. teysmannii var. *inophyllolide* [80]
$[\alpha]_D$ +70° ($CHCl_3$) [73]
UV (EtOH) [73]: 240 (4.32), 257 (4.46), 266 (4.49), 302 (4.39)
IR (mineral oil) [73]: 1727, 1688, 767, 703
Mass [73]: 402 $[M]^+$, 387 (15), 331 (56), 303 (28)

PMR (60 MHz, $CDCl_3$) [73]: 0.97 (6H, s, CH_3-6, CH_3-6), 1.18 (3H, d, J = 7.2, CH_3-11), 1.44 (3H, d, J = 6.8, CH_3-10), 2.67 (1H, m, J = 7.2, J = 3.7, H-11), 4.73 (1H, m, J = 6.8, J = 3.7, H-10), 5.42 (1H, d, J = 10.0, H-7), 6.05 (1H, s, H-3), 6.56 (1H, d, J = 10.0, H-8), 7.3 (5H, m, Ph)
^{13}C NMR (100 MHz, $CDCl_3$) [74]:

C-2	159.4	C-8	115.2	C-12a	103.8	C-17	127.6
3	113.3	8a	105.4	12b	154.8	18	127.6
4	159.3	8b	155.3	13	139.8	19	27.3
4a	102.7	10	77.2	14	127.6	20	27.2
4b	155.6	11	45.9	15	127.6	21	16.0
6	78.6	12	191.5	16	127.3	22	9.1
7	127.4						

Biol: inhibitor of HIV-1 RT at IC_{50} 100 µM [74], antitumor activity [9]

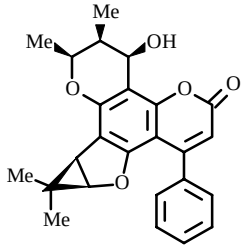


56. Inophyllum G-1

Calophyllum inophyllum [74]
$C_{26}H_{26}O_5$
$[\alpha]_D$ +174.2° ($CDCl_3$) [74]
UV (MeOH) [74]: 216, 219, 315, 333
IR (KBr) [74]: 3600-3200, 3100-3000, 2850, 1719, 1700, 1142, 1097, 853, 766, 736, 700
HRCIMS [74]: 404.1610

PMR (400 MHz, $CDCl_3$) [74]: 0.71 (3H, s, CH_3-20), 1.05 (3H, s, CH_3-19), 1.20 (3H, d, J = 7.1, CH_3-22), 1.45 (3H, d, J = 6.8, CH_3-21), 2.34 (1H, ddq, J = 3.8, J = 4.8, J = 7.1, H-11), 2.46 (1H, d, J = 5.7, H-8), 4.23 (1H, d, J = 5.7, H-6), 4.46 (1H, ddq, J = 0.8, J = 3.8, J = 6.8, H-10), 5.12 (1H, dd, J = 4.8, J = 0.8, H-12), 6.01 (1H, s, H-3), 7.41, 7.31 (5H, m, Ph-4)
^{13}C NMR (100 MHz, $CDCl_3$) [74]:

C-2	160.5	C-8	29.4	C-12a	106.1	C-17	127.7
3	111.2	8a	112.0	12b	153.2	18	127.7
4	155.0	8b	153.4	13	137.6	19	22.5
4a	99.0	10	75.9	14	127.7	20	12.7
4b	158.4	11	35.6	15	127.7	21	15.9
6	72.9	12	62.7	16	127.8	22	10.5
7	13.0						



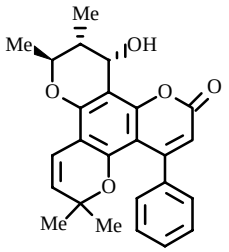
57. Inophyllum G-2

Calophyllum inophyllum [74]
$C_{26}H_{26}O_5$
$[\alpha]_D$ -49.1° ($CDCl_3$) [74]
UV (MeOH) [74]: 215, 217, 224, 335
IR (KBr) [74]: 3600-3200, 3100-3000, 3000-2800, 1718, 1699, 1142, 1095, 855, 770, 741, 701
HRCIMS [74]: 404.1610

PMR (400 MHz, $CDCl_3$) [74]: 0.73 (s, 3H, CH_3-20), 1.05 (s, 3H, CH_3-19), 1.18 (d, J = 7.1, 3H, CH_3-22), 1.45 (d, J = 6.8, 3H, CH_3-21), 2.33 (ddq, J = 3.3, J = 5.3, J = 7.1, 1H, H-11), 2.42 (d, J = 5.7, 1H, H-8), 4.21 (d, J = 5.7, 1H, H-6), 4.40 (ddq, J = 0.8, J = 3.3, J = 6.8, 1H, H-10), 5.18 (dd, J = 5.3, J = 0.8, 1H, H-12), 6.02 (s, 1H, H-3), 7.42, 7.32 (m, 5H, Ph-4)
^{13}C NMR (100 MHz, $CDCl_3$) [74]:

C-2	160.5	C-8	29.3	C-12a	106.0	C-17	127.7
3	111.2	8a	111.9	12b	153.2	18	127.7
4	154.9	8b	153.8	13	137.6	19	22.6
4a	98.9	10	75.7	14	127.7	20	12.6
4b	158.4	11	35.8	15	127.7	21	16.0
6	72.8	12	63.4	16	127.8	22	9.6
7	13.0						

Biol: inhibitor of HIV-1 RT at IC_{50} 70 µM [74]



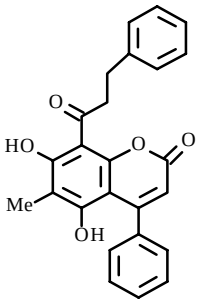
58. Inophyllum P

Calophyllum inophyllum [74, 77]
$C_{25}H_{24}O_5$
$[\alpha]_D$ +19.8° ($CDCl_3$) [74], +31.4° [76]
UV (MeOH) [74]: 207, 235, 280, 286, 334
IR (KBr) [74]: 3435, 2930, 2860, 1719, 1640, 1590, 1565, 765, 703
HRCIMS [74]: 405.1732 $[M + H]^+$

PMR (400 MHz, $CDCl_3$) [74]: 0.93 (6H, s, CH_3-19, CH_3-20), 1.17 (3H, d, J = 7.0, CH_3-22), 1.44 (3H, d, J = 6.3, CH_3-21), 1.79 (1H, ddq, J = 3.3, J = 7.0, J = 10.6, H-11), 4.29 (1H, dq, J = 6.3, J = 10.6, H-10), 5.04 (1H, d, J = 3.3, H-12), 5.37 (1H, d, J = 10.0, H-7), 5.97 (1H, s, H-3), 6.54 (1H, d, J = 10.0, H-8), 7.42, 7.30 (5H, m, Ph-4)
X-ray [76]
^{13}C NMR (100 MHz, $CDCl_3$) [74]:

C-2	160.1	C-8	115.9	C-12a	106.1	C-17	127.3
3	111.5	8a	106.3	12b	154.1	18	127.3
4	156.4	8b	153.7	13	139.9	19	26.5
4a	103.6	10	76.9	14	127.3	20	26.9
4b	150.9	11	40.4	15	127.3	21	18.9
6	77.2	12	67.1	16	127.4	22	15.0
7	127.6						

Biol: inhibitor of HIV-1 RT at IC_{50} 0.130 µM [74], activity against HIV-1 in cell culture at IC_{50} 1.6 µM [74]



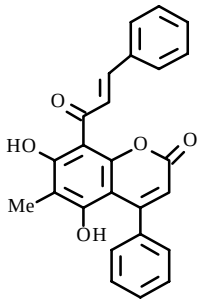
59. Interruptin A

Cyclosorus interruptus [81]
$C_{25}H_{20}O_5$, **mp** 143-145°C [81]
UV (MeOH) [81]: 214, 283, 417
Mass [81]: 400 (36) $[M]^+$, 382 (7), 295 (100), 91 (24)
PMR (300 MHz, $CDCl_3$) [81]: 2.28 (3H, s, Me-6), 2.96 (2H, t, J = 7.6, CH_2-3′), 3.29 (2H, t, J = 7.6, CH_2-2′), 5.95 (1H, s, H-3), 7.16-7.29 (5H, m, H-5′, H-6′, H-8′, H-9′, H-4″), 7.43-7.47 (2H, m, H-2″, H-6″), 7.53-7.61 (3H, m, H-7′, H-3″, H-5″), 12.89 (1H, s, OH-7)

^{13}C NMR (75 MHz, $CDCl_3$) [81]:

C-2	159.4	C-8	107.0	C-5′	128.4	C-2″	127.5
3	112.8	8a	157.1	6′	128.4	3″	130.0
4	153.4	1′	206.1	7′	130.6	4″	126.0
4a	99.9	2′	46.8	8′	128.4	5″	130.0
5	156.9	3′	30.3	9′	128.4	6″	127.5
6	106.0	4′	141.2	1″	136.1	Me-6	7.5
7	164.5						

Biol: antibacterial activity against *Bacillus cereus, Staphylococcus epidermidis*, and *M. luteus* [81], cytotoxic activity against cell line KB [81]



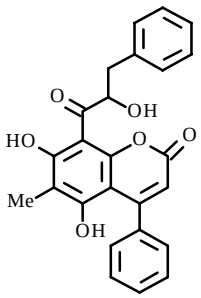
60. Interruptin B

Cyclosorus interruptus [81]
$C_{25}H_{18}O_5$, **mp** 222-224°C [81]
UV (MeOH) [81]: 223, 328, 331
Mass [81]: 398 (11) $[M]^+$, 321 (8), 294 (4), 266 (3), 91 (4), 44 (100)
PMR (300 MHz, $CDCl_3$) [81]: 2.05 (3H, s, Me-6), 5.84 (1H, s, OH-5), 6.04 (1H, s, H-3), 7.43-7.50 (6H, m, H-5′, H-7′, H-9′, H-2″, H-4″, H-6″), 7.59-7.62 (2H, m, H-3″, H-5″), 7.74-7.77 (2H, m, H-6′, H-8′), 7.95 (1H, d, J = 15.5, H-3′), 8.28 (1H, d, J = 15.5, H-2′), 14.72 (1H, s, OH-7)

^{13}C NMR (75 MHz, $CDCl_3$) [81]:

C-2	158.5	C-8	104.7	C-5′	128.9	C-2″	127.6
3	112.1	8a	155.0	6′	129.0	3″	130.0
4	153.7	1′	192.8	7′	130.6	4″	130.7
4a	100.3	2′	126.4	8′	129.0	5″	130.0
5	156.9	3′	145.0	9′	128.9	6″	127.6
6	109.4	4′	135.0	1″	136.0	Me-6	7.6
7	167.5						

Biol: cytotoxic activity against cell line KB [81]



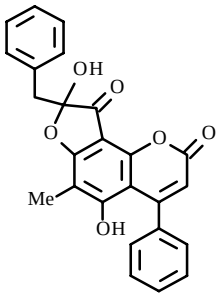
61. Interruptin C

Cyclosorus interruptus [81]
$C_{25}H_{20}O_6$
UV (MeOH) [81]: 290, 360
Mass [81]: 441 (25) $[M + 2H + Na]^+$, 417 (54) $[M + H]^+$, 295 (80)
PMR (300 MHz, CD_3OD) [81]: 2.27 (3H, s, Me-6), 2.77 (1H, dd, J = 8.7, J = 13.8, H-3′b), 3.18 (1H, dd, J = 3.8, J = 13.8, H-3′a), 5.31 (1H, dd, J = 3.8, J = 8.7, H-2′), 5.91 (1H, s, H-3), 7.07-7.09 (2H, m, H-6′, H-8′), 7.18-7.23 (1H, m, H-4″), 7.24 -7.26 (3H, m, H-5′, H-7′, H-9′), 7.28-7.36 (2H, m, H-3″, H-5″), 7.39-7.48 (2H, m, H-2″, H-6″)

HMBC [81]
^{13}C NMR (75 MHz, CD_3OD) [81]:

C-2	162.0	C-8	*	C-5′	130.6	C-2″	129.2
3	112.6	8a	150.0	6′	128.8	3″	128.3
4	*	1′	207.9	7′	127.5	4″	129.3
4a	103.5	2′	79.0	8′	128.8	5″	128.3
5	163.2	3′	41.3	9′	130.6	6″	129.2
6	105.1	4′	139.0	1″	134.8	Me-6	8.1
7	159.8						

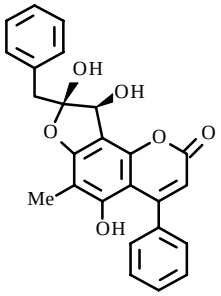
*Signals cannot be acccurately defined owing to low intensities



62. Interruptin D

Cyclosorus interruptus [81]
$C_{25}H_{18}O_6$, **mp** 181-183°C [81]
UV (MeOH) [81]: 207, 288, 372, 400
Mass [81]: 415 (100) $[M + H]^+$, 397 (5), 295 (20)
PMR (300 MHz, $CDCl_3$) [81]: 2.25 (3H, s, Me-6), 3.00 (2H, s, CH_2-3′), 6.08 (1H, s, H-3), 6.80 (2H, d, J = 6.9, H-5′, H-9′), 7.15-7.31 (3H, m, H-6′, H-7′, H-8′), 7.38-7.49 (5H, m, H-2″, H-3″, H-4″, H-5″, H-6″)
^{13}C NMR (75 MHz, CD_3OD) [81]:

C-2	159.5	C-8	103.8	C-5′	130.5	C-2″	128.0
3	112.5	8a	165.2	6′	128.7	3″	128.0
4	154.1	1′	197.1	7′	127.8	4″	129.3
4a	100.1	2′	105.7	8′	128.7	5″	128.0
5	157.0	3′	41.1	9′	130.5	6″	129.0
6	107.0	4′	131.0	1″	136.8	Me-6	7.1
7	161.7						



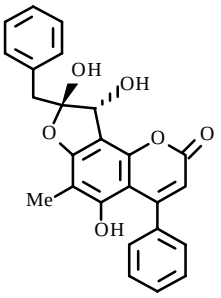
63. Interruptin E

Cyclosorus interruptus [81]
$C_{25}H_{20}O_6$, **mp** 118-120°C [81]
UV (MeOH) [81]: 210, 268, 331
Mass [81]: 398 (100) $[M - H_2O]^+$, 321 (82), 294 (36)
PMR (300 MHz, DMSO-d_6) [81]: 2.16 (3H, s, Me-6), 2.79 (1H, d, J = 14.0, H-3′a), 3.09 (1H, d, J = 14.2, H-3′b), 4.71 (1H, d, J = 8.1, H-1′), 5.34 (1H, d, J = 8.6, OH-1′), 5.90 (1H, s, H-3), 6.66 (1H, s, OH-2′), 7.05-7.12 (2H, m, H-5′, H-9′), 7.07-7.47 (4H, m, H-2″, H-3″, H-5″, H-6″), 7.10-7.16 (1H, m, H-7′), 7.37-7.51 (3H, m, H-6′, H-8′, H-4″)
^{13}C NMR (75 MHz, DMSO-d_6) [81]:

C-2	160.6	C-8	112.5	C-5′	130.5	C-2″	127.4
3	110.1	8a	*	6′	128.3	3″	127.6
4	*	1′	73.9	7′	125.7	4″	128.8
4a	97.7	2′	113.0	8′	128.3	5″	127.6
5	156.2	3′	39.4	9′	130.5	6″	127.4
6	104.1	4′	136.2	1″	137.3	Me-6	8.1
7	154.9						

*Signals cannot be accurately defined owing to low intensities

Biol: antibacterial activity against *Bacillus cereus, Staphylococcus epidermidis*, and *M. luteus* [81]



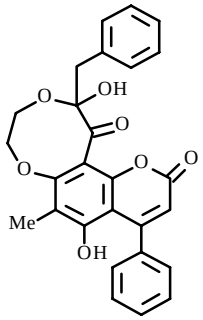
64. Interruptin F

Cyclosorus interruptus [81]
$C_{25}H_{20}O_6$, **mp** 118-120°C [81]
UV (MeOH) [81]: 210, 268, 331
Mass [81]: 398 (100) $[M - H_2O]^+$, 321 (82), 294 (36)
PMR (300 MHz, DMSO-d_6) [81]: 2.14 (3H, s, Me-6), 2.74 (1H, d, J = 13.8, H-3′a), 2.91 (1H, dd, J = 14.5, J = 0.6, H-3′b), 4.82 (1H, d, J = 5.0, H-1′), 5.44 (1H, d, J = 6.0, OH-1′), 5.87 (1H, s, H-3), 6.40 (1H, s, OH-2′), 7.05-7.12 (2H, m, H-5′, H-9′), 7.07-7.47 (4H, m, H-2″, H-3″, H-5″, H-6″), 7.10-7.22 (1H, m, H-7′), 7.37-7.51 (3H, m, H-6′, H-8′, H-4″)
^{13}C NMR (75 MHz, DMSO-d_6) [81]:

C-2	159.0	C-8	*	C-5′	130.4	C-2″	127.4
3	109.9	8a	*	6′	128.2	3″	127.7
4	*	1′	68.3	7′	126.3	4″	128.7
4a	102.5	2′	111.8	8′	128.2	5″	127.7
5	156.6	3′	42.4	9′	130.4	6″	127.4
6	97.7	4′	135.4	1″	137.4	Me-6	8.1
7	153.9						

*Signals cannot be accurately defined owing to low intensities

Biol: antibacterial activity against *Bacillus cereus, Staphylococcus epidermidis*, and *M. luteus* [81]

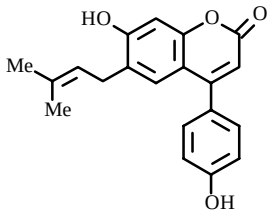


65. Interruptin G

Cyclosorus interruptus [81]
$C_{27}H_{22}O_7$, **mp** 162-164°C [81]
UV (MeOH) [81]: 208, 290, 375, 407
Mass [81]: 460 (6) $[M + 2H]^+$, 398 (66), 395 (100)
PMR (300 MHz, DMSO-d_6) [81]: 2.08 (3H, s, Me-6), 2.76 (1H, d, J = 14.1, H-3′a), 2.94 (1H, d, J = 14.1, H-3′b), 3.41 (2H, t, J = 5.3, CH_2-11′), 3.49 (2H, t, J = 5.2, CH_2-10′), 6.00 (1H, s, H-3), 6.81-6.83 (2H, m, H-5′, H-9′), 7.11-7.13 (3H, m, H-7′, H-3″, H-5″), 7.38-7.39 (2H, m, H-2″, H-6″), 7.48-7.51 (3H, m, H-6′, H-8′, H-4″), 7.82 (1H, s, OH-2′)
^{13}C NMR (75 MHz, DMSO-d_6) [81]:

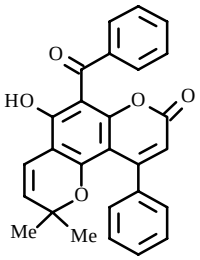
C-2	158.9	C-8	105.0	C-6′	127.7	C-2″	128.0
3	111.2	8a	166.1	7′	126.6	3″	127.7
4	154.0	1′	195.2	8′	127.7	4″	129.0
4a	98.4	2′	106.4	9′	130.1	5″	127.7
5	156.5	3′	40.8	10′	60.2	6″	128.0
6	105.4	4′	133.4	11′	72.3	Me-6	7.7
7	159.8	5′	130.1	1″	136.9		

Biol: antibacterial activity against *Staphylococcus epidermidis* and *M. luteus* [81]



66. Inflacoumarin A

Glycyrrhiza inflata [82, 83]
$C_{20}H_{18}O_4$



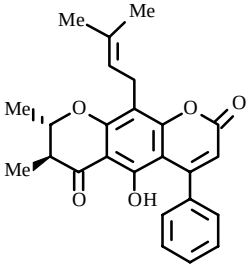
67. Calanone

Calophyllum teysmannii var. *inophyllolide* [14, 20, 79, 80]
$C_{27}H_{20}O_5$
UV (EtOH) [79]: 242 (4.17), 274 (4.32), 320 (4.01)
IR [79]: 3455, 3065, 2979, 2921, 1738, 1607, 1597, 1571, 1442, 1360, 1270, 1135
HRFABMS [79]: 425.1366 $[MH]^+$
PMR (500 MHz, $CDCl_3$) [79]: 0.98 (6H, s, CH_3-12, CH_3-13), 5.42 (1H, d, J = 10.5, H-7), 5.88 (1H, s, H-3), 6.64 (1H, d, J = 10.5, H-8), 7.23 (2H, m, H-2′, H-6′), 7.37 (3H, m, H-3′, H-4′, H-5′), 7.46 (2H, t, J = 8.0, H-3″, H-5″), 7.57 (1H, tt, J = 8.0, J = 1.7, H-4″), 7.65 (2H, dd, J = 8.0, J = 1.7, H-2″, H-6″), 12.46 (s, 1H, OH-7)
HMBC, HMQC [79]
X-ray [71]
^{13}C NMR (125 MHz, $CDCl_3$) [79]:

C-2	158.0	C-8	115.2	C-13	27.4	C-1″	140.3
3	112.6	8a	105.7	1′	139.7	2″	128.2
4	155.3	9	161.5	2′	127.2	3″	128.2
4a	102.4	10	103.8	3′	127.5	4″	132.3
4b	156.4	10a*	155.9	4′	127.8	5″	128.2
6	79.1	11	198.8	5′	127.5	6″	128.2
7	127.0	12	27.4	6′	127.2		

*Assignments may be reversed

Biol: cytotoxic activity against cell lines P388, WEHI164, THP-1, and MOLT4 [14]



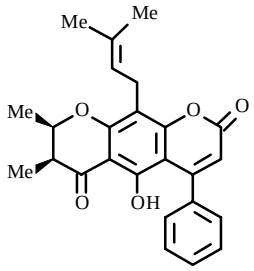
68. Calaustralin

Calophyllum australianum [84]
$C_{25}H_{24}O_5$, **mp** 192-193.5°C [84]
UV (EtOH-OH^-) [84]: 286, 315, 425
IR [84]: 1718, 1645, 1613
Mass [14]: 404 (85) $[M]^+$, 389 (80), 361 (100), 349 (45), 333 (65), 305 (75)
HREIMS [14]: 404.1629 $[M]^+$
PMR (300 MHz, $CDCl_3$) [14]: 1.21 (3H, d, J = 7.1, CH_3-16), 1.56 (3H, d, J = 6.2, CH_3-17), 1.69 (3H, s, CH_3-15), 1.85 (3H, s, CH_3-14), 2.64 (1H, dq, J = 12.2, J = 7.1, H-7), 3.46 (2H, d, J = 7.5, CH_2-11), 4.27 (1H, dq, J = 12.2, J = 6.2, H-8), 5.25 (1H, m, J = 7.5, H-12), 6.00 (1H, s, H-3), 7.30-7.41 (5H, m, Ph), 13.12 (1H, s, OH)

^{13}C NMR (75 MHz, $CDCl_3$) [14]:

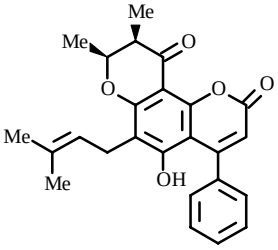
C-2*	160.6	C-7	45.9	C-11	21.6	C-1′	138.9
3	113.0	8	79.1	12	121.2	2′	127.3
4**	155.8	8a	105.7	13	132.7	3′	128.4
4a***	102.3	9	161.5	14	25.8	4′	127.7
5*	159.8	9a*	160.5	15	18.0	5′	128.4
5a***	108.8	10***	103.5	16	10.0	6′	127.3
6	200.1	10a**	159.1	17	19.6		

*,**,***Assignments may be reversed



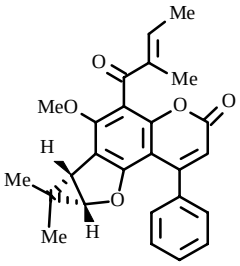
69. (-)-Calaustralin

Calophyllum inophyllum [85]
$C_{25}H_{24}O_5$, **mp** 197-198°C [85]
UV (EtOH) [85]: 285, 335; (EtOH+NaOH): 285, 313, 424
IR (mineral oil) [85]: 1728, 1625, 1597, 1375, 1160, 1110, 900, 835, 703
Mass [85]: 404 (76) $[M]^+$, 389 (56), 361 (100), 349 (20), 336 (16), 333 (24), 305 (36), 293 (16), 280 (12), 277 (14)
PMR (60 MHz, $CDCl_3$) [85]: 1.15 (3H, d, J = 6), 1.55 (3H, d, J = 6), 1.65 (3H, s), 1.85 (3H, s), 2.59 (1H, m), 3.45 (2H, d, J = 7), 4.25 (1H, m), 5.30 (1H, d, J = 7), 6.00 (1H, s), 7.40 (5H, s), 12.75 (1H, OH)



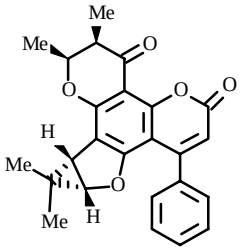
70. Calocoumarin A

Calophyllum inophyllum [86]
$C_{25}H_{24}O_5$
Biol: antitumor activity [86]



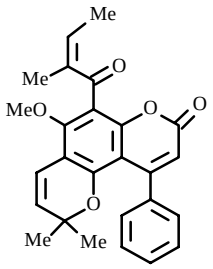
71. Calocoumarin B

Calophyllum inophyllum [86]
$C_{26}H_{25}O_5$
Biol: antitumor activity [86]



72. Calocoumarin C

Calophyllum inophyllum [86]
$C_{25}H_{22}O_5$
Biol: antitumor activity [86]

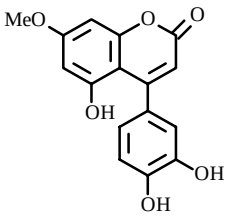


73. Calophyllolide

Calophyllum inophyllum [1, 77, 87, 88, 89], *C. bracteatum* [90], *C. aff. pervillei* [91]
$C_{26}H_{24}O_5$, **mp** 152-154°C [90], 156°C [5], 158-160°C [1], 159-160°C [87]
UV (EtOH) [1]: 235 (4.47), 270 (4.27), 295 (4.22), 325 (4.27)
Mass [5]: 416 (31) $[M]^+$, 401 (100), 361 (12), 331 (13)
PMR (300 MHz, $CDCl_3$) [5]: 0.97 (6H, s, Me_2CH), 1.90 (3H, dd, J = 7.0, J = 1.0, MeCH=C), 2.01 (3H, m, MeCCO), 3.75 (3H, s, MeO), 5.48 (1H, d, J = 10.0, ArCH=CH), 6.02 (s, 1H, C=CHCO), 6.45 (1H, d, J = 10.0, 1H, ArCH=CH), 6.53-6.61 (1H, dq, J = 1.3, J = 7.0, MeCH=C), 7.23-7.27 and 7.37-7.43 (5H, two m, Ph)
^{13}C NMR (75 MHz, $CDCl_3$) [5]:

C-2	159.5	C-7	129.0	C-12	194.3	C-15	127.8
3	114.2	8	116.0	12a	115.0	16	26.9
4	155.0	8a	110.7	12b	152.0	17	26.9
4a	105.6	8b	155.8	13	127.3	18	15.2
4b	151.7	10	144.2	13a	139.5	19	10.7
6	77.4	11	139.9	14	127.5	OMe	63.0

Biol: antitumor activity [86]

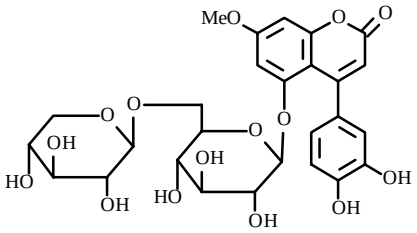


74. Coutareagenin (5,3′,4′-trihydroxy-7-methoxyneoflavone)*
*structure corrected after re-examination [93]

Coutarea hexandra [92, 93]
$C_{16}H_{12}O_6$, **mp** 193-194°C [93], 208-210°C [92]
UV (MeOH) [93]: 261 (4.22), 329 (4.26); (MeOH+NaOMe): 278, 336, 405; (MeOH+$AlCl_3$): 260, 329; (MeOH+$AlCl_3$+HCl): 260, 329; (MeOH+NaOAc): 274, 330, 362, 400; (MeOH+NaOAc+H_3BO_3): 260, 330, 400
IR (KBr) [92]: 3350, 1675, 1630, 1175, 1165, 1085
Mass [93]: 300 (100) $[M]^+$, 299 (13.4), 273 (16.2), 272 (93.6), 257 (22.5), 243 (7.3)
PMR (270 MHz, DMSO-d_6) [93]: 3.79 (3H, s, 7-OMe), 5.76 (1H, s, H-3), 6.24 (1H, d, J = 2.19, H-6), 6.49 (1H, d, J = 2.19, H-8), 6.61 (1H, dd, J = 2.20, J = 7.20, H-6′), 6.71 (1H, d, J = 2.20, H-2′), 6.72 (1H, d, J = 7.20, H-5′), 8.96 (1H, s, OH), 9.07 (1H, s, OH), 10.23 (1H, s, OH)
^{13}C NMR [100.6 MHz, $(CD_3)_2CO$] [92]:

C-2	164.1	C-6	94.4	C-10	103.1	C-4′	116.0
3	112.5	7	160.6	1′	131.7	5′	146.6
4	158.2	8	99.4	2′	145.3	6′	120.3
5	157.3	9	156.3	3′	115.6	OMe	56.1

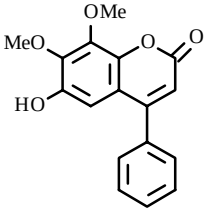
Biol: inhibits ATP synthesis and proton absorption in chloroplasts [38], antidiabetic agent [94]



75. 5-O-[β-D-Xylopyranosyl-(1→6)-β-D-glucopyranosyl]-7-methoxy-3′,4′-dihydroxy-4-phenylcoumarin

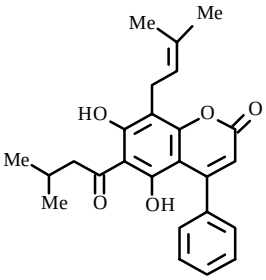
Coutarea hexandra [10]
$C_{27}H_{30}O_{15}$
Mass [10]: 593 $[M - H]^-$, 461, 299
PMR (250 MHz, CD_3OD) [10]: 2.62 (1H, dd, J = 7.5, J = 7.5, G-2″), 3.88 (3H, s, OMe), 4.25 (1H, d, J = 7.5, X-1″), 4.80 (1H, d, J = 7.5, G-1″), 5.91 (1H, s, H-3), 6.65 (1H, d, J = 2, H-8), 6.70 (1H, d, J = 2, H-6), 6.71 (1H, dd, J = 2, J = 7.5, H-6′), 6.80 (1H, d, J = 7.5, H-5′), 6.80 (1H, d, J = 2, H-2′)
^{13}C NMR (69.5 MHz, CD_3OD) [10]:

C-2	162.9	C-1′	133.0	G-1″	101.6	X-1″	105.5
3	113.3	2′	117.0	2″	74.6	2″	74.9
4	158.1	3′	145.5	3″	77.7	3″	77.3
4a	105.8	4′	147.0	4″	71.1	4″	71.4
5	158.1	5′	115.9	5″	77.7	5″	66.8
6	96.6	6′	120.7	6″	70.3	OMe	56.6
7	165.0						
8	100.6						
8a	157.1						



76. Kuhlmannin

Machaerium kuhlmannii [56, 95], *M. nictitans* [56, 95], *M. pedicellatum* [58], *Piptadenia macrocarpa* [59]
$C_{17}H_{14}O_5$, **mp** 211°C [56]
UV (EtOH) [56]: 214 (4.39), 300 (3.81)
IR ($CHCl_3$) [56]: 3500, 1710, 1555, 1395
PMR (60 MHz, $CDCl_3$) [56]: 4.08 (3H, s), 4.11 (3H, s), 4.27 (1H, s), 6.3 (1H, s), 6.77 (1H, s), 7.49 (5H, s)



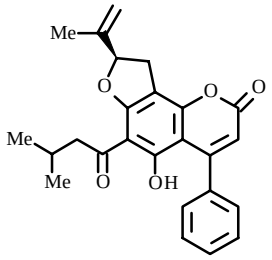
77. Mammea A/AA (mammeisin)

Mammea americana [96, 97], *M. africana* [98, 99], *Mesua ferrea* [100], *M. racemosa* [101], *M. thwaitesii* [102], *Kayea assamica* [103], *Kielmeyera elata* [29]
$C_{25}H_{26}O_5$, **mp** 83°C [99], 92-112°C [104], 97°C [103], 98-100°C [100], 98-109°C [97]
$[\alpha]_D$ +22° [103]
UV (EtOH) [97]: 281 (4.41), 338 (4.00); (EtOH+HCl): 249 (3.96), 317 (3.94); (EtOH+NaOH): 243 (4.10), 301 (4.36), 427 (4.10)
IR (KBr) [97]: 1745, 1620, 1597, 766, 698; ($CDCl_3$): 3436, 3289, 1730, 1621, 1587
Mass [105]: 406 (85) $[M]^+$, 363 (10), 351 (100), 349 (19), 293 (50)
HRMS [105]: 406.1179 $[M]^+$
PMR (250 MHz, $CDCl_3$) [105]: 0.9 (6H, d, J = 7, Me_2CH), 1.74 and 1.88 (6H, two s, Me_2C=CH), 2.16 (1H, m, J = 7, Me_2CHCH_2), 2.84 (2H, d, J = 7, $CHCH_2CO$), 3.52 (2H, d, J = 7, $ArCH_2CH$), 5.2 (1H, t, J = 7, Me_2C=$CHCH_2$), 5.88 (1H, s, PhC=CHCO), 7.3-7.6 (5H, m, ArH), 9.8 (1H, s, OH), 11.2 (1H, s, OH)

^{13}C NMR (67.5 MHz, $CDCl_3$) [101]:

C-2	159.2	C-7	163.3	C-4′	129.7	C-4″	22.6
3	112.7	8	108.0	5′	129.1	1‴	21.7
4	154.4	8a	156.6	6′	127.4	2‴	120.6
4a	100.8	1′	137.2	1″	207.1	3‴	135.5
5	159.5	2′	127.4	2″	53.6	4a‴	18.0
6	107.3	3′	129.1	3″	24.7	4b‴	25.8

Biol: inhibitor of oxidative phosphorylation at 0.5 µg/mL [106]



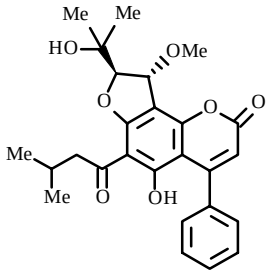
78. Mammea A/AA dehydrocyclo F

Calophyllum dispar [66]
$C_{25}H_{24}O_5$
UV (EtOH) [66]: 230 (3.79), 283 (4.04), 346 (3.61); (EtOH-NaOH): 250 (3.93), 284 (3.79), 315 (3.74), 428 (3.64)
IR ($CHCl_3$) [66]: 3430, 3060, 2960, 1746, 1617, 768, 700
HREIMS [66]: 404.1637 $[M]^+$

PMR (270 MHz, $CDCl_3$) [66]: 0.96 (6H, d, J = 6.5, CH_3-4″, CH_3-5″), 1.83 (3H, s, CH_3-6‴), 2.18 (1H, m, H-3″), 2.90 (1H, dd, J = 3.0, J = 7.0, CH_2-2″), 3.15 (1H, dd, J = 8.0, J = 15.0, CH_2-3‴α), 3.50 (1H, dd, J = 10.0, J = 15.0, CH_2-3‴β), 5.03 (1H, s, H-5‴b), 5.15 (1H, s, H-5‴a), 5.48 (1H, t, J = 9.0, H-2‴), 5.94 (1H, s, H-3), 7.32 (2H, m, H-2′, H-6′), 7.41 (3H, m, H-3′, H-4′, H-5′), 14.55 (1H, s, OH-5)
DQF-COSY, HMQC, HMBC, NOESY [66]
^{13}C NMR (67.5 MHz, $CDCl_3$) [66]:

C-2	159.7	C-9	155.6	C-5′	127.5	C-5″	22.5
3	111.9	10	102.2	6′	127.1	2‴	89.1
4	156.5	1′	139.0	1″	205.3	3‴	30.5
5	164.5	2′	127.1	2″	51.7	4‴	142.2
6	103.2	3′	127.5	3″	25.3	5‴	113.2
7	164.5	4′	128.1	4″	22.5	6‴	17.1
8	104.5						

Biol: cytotoxic activity against cell line KB at ED_{50} 40 µg/mL [66]



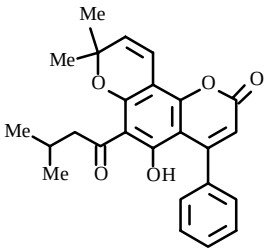
79. Mammea A/AA methoxycyclo F

Calophyllum dispar [66]
$C_{26}H_{28}O_7$
UV (EtOH) [66]: 245 (4.01), 282 (4.04), 349 (3.65); (EtOH+NaOH): 241 (3.89), 282 (4.09), 328 (3.75), 414 (3.12)
IR ($CHCl_3$) [66]: 3410, 1734, 1719, 1617, 768, 699
HRLSIMS [66]: 453.1920 $[M + H]^+$

PMR (270 MHz, $CDCl_3$) [101]: 0.96 (6H, d, J = 7.0, CH_3-4″, CH_3-5″), 1.35 (1H, s, CH_3-5‴), 1.39 (1H, s, CH_3-6‴), 2.21 (1H, m, H-3″), 2.81 (1H, dd, J = 7.0, J = 15.0, CH_2-2″α), 3.00 (1H, dd, J = 7.0, J = 15.0, CH_2-2″β), 3.64 (3H, s, OMe-3‴), 4.65 (1H, d, J = 3.0, H-2‴), 5.23 (1H, d, J = 3.0, H-3‴), 5.99 (1H, s, H-3), 7.31 (2H, m, H-2′, H-6′), 7.40 (3H, m, H-3′, H-4′, H-5′), 14.75 (1H, s, OH-5)

HMBC [66]
^{13}C NMR (67.5 MHz, $CDCl_3$) [101]:

C-2	159.8	C-9	156.8	C-6′	127.2	C-2‴	97.7
3	112.5	10	102.8	1″	205.1	3‴	78.6
4	156.5	1′	139.0	2″	52.0	4‴	71.2
5	166.5	2′	127.2	3″	25.0	5‴	25.5
6	103.3	3′	127.7	4″	22.6	6‴	25.9
7	164.4	4′	128.3	5″	22.6	OMe-3‴	57.7
8	105.9	5′	127.7				

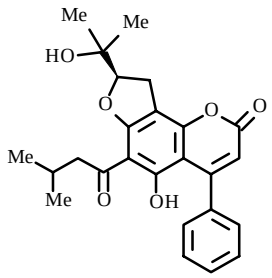


80. Mammea A/AA cyclo D (mammeigin)

Mammea americana [107, 108], *Mesua ferrea* [104, 109], *M. thwaitesii* [102], *Kielmeyera pumila* [110], *K. elata* [29], *K. lathrophyton* [111]
$C_{25}H_{24}O_5$, **mp** 144-146°C [108], 148-150°C [110], 149-150°C [109], 150-151°C [112]
UV (EtOH) [110]: 235 (4.43), 288 (4.49), 370 (3.82); (EtOH+NaOH): 230 (4.25), 252 (4.36), 312 (4.41); (EtOH+NaOAc): 240 (4.29), 305 (4.32)
IR (KBr) [110]: 3440, 1745, 1645, 1615, 1380, 1125, 775, 750, 710
Mass [110]: 404 (34) $[M]^+$, 389 (100), 371 (27), 347 (21), 105 (11), 77 (11), 42 (20)
PMR (300 MHz, $CDCl_3$) [111]: 0.94 (6H, d, J = 6.7, Me-4″, Me-5″), 1.60 (6H, s, Me-7′, Me-8′), 2.19 (1H, m, H-3″), 2.90 (2H, d, J = 6.9, CH_2-2″), 5.60 (1H, d, J = 10.0, H-5′), 5.99 (1H, s, H-3), 6.90 (1H, d, J = 10.0, H-4′), 7.30 (1H, m, Ph-4), 7.40 (4H, m, Ph-4), 14.73 (1H, s, OH-5)
^{13}C NMR (75 MHz, $CDCl_3$) [111]:

C-2	159.6	C-8	101.4	C-1″	206.7	C-1‴	139.2
3	112.6	8a	157.8	2″	53.5	2‴	127.1
4	154.7	4′	115.5	3″	25.0	3‴	127.5
4a	102.2	5′	126.2	4″	22.6	4‴	128.1
5	164.5	6′	79.8	5″	22.6	5‴	127.5
6	106.9	7′	28.1			6‴	127.1
7	156.4	8′	28.1				

Biol: inhibitor of oxidative phosphorylation at 0.5 µg/mL [106]



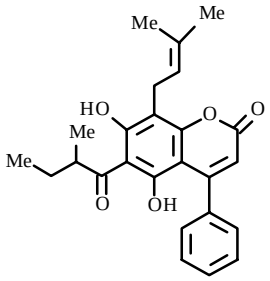
81. Mammea A/AA cyclo F (cyclomammeisin)

Mammea americana [113], *Mesua thwaitesii* [102], *Kayea assamica* [103], *Kielmeyera elata* [29], *Calophyllum dispar* [66]
$C_{25}H_{26}O_6$, **mp** 105°C [103], 115-117°C [114], 131-132°C [105], 148-150°C [113]
UV (EtOH) [105]: 280, 347; (EtOH+KOH): 247, 313
IR ($CDCl_3$) [105]: 3050, 1720, 1610
Mass [105]: 422 (22) $[M]^+$, 365 (38), 364 (78), 363 (62), 347 (28), 307 (70), 293 (100)
PMR (250 MHz, $CDCl_3$) [105]: 0.94 (6H, d, J = 7, Me_2CH), 1.28 and 1.48 (6H, two s, Me_2CCH), 2.04 (1H, s, Me_2COH), 2.14 (1H, m, Me_2CHCH_2), 2.84 (2H, dd, J = 7, J = 5, $CHCH_2CO$), 3.24 (2H, d, J = 9, $ArCH_2CH$), 4.80 (1H, t, J = 9,

Me_2CCHCH_2), 5.72 (1H, s, PhC=CHCO), 7.0-7.2 (5H, m, ArH), 15.0 (1H, s, OH)
^{13}C NMR (67.5 MHz, $CDCl_3$) [66]:

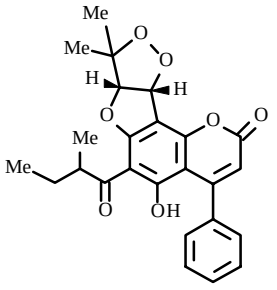
C-2	159.8	C-8	92.9	C-3′	127.5	C-3″	25.0
3	111.8	9	26.6	4′	128.2	4″	22.6
4	156.6	9a	105.1	5′	127.5	5″	22.6
4a	102.3	9b	155.5	6′	127.2	1‴	71.4
5	164.3	1′	138.9	1″	205.2	2‴	26.3
6	103.3	2′	127.2	2″	51.9	3‴	24.9
6a	164.2						

Biol: cytotoxic activity against cell line KB at ED_{50} 6 µg/mL [66]



82. Mammea A/AB (MAB 1)

Mammea africana [98, 99], *M. americana* [115, 116]
$C_{25}H_{26}O_5$, **mp** 75°C [98], 105-106°C [99], 107-108°C [115], 109-110°C [105]
UV (MeOH+HCl) [98]: 232 (4.24), 282 (4.47), 336 (4.01); (MeOH+KOH): 237 (4.35), 300 (4.27), 390 (3.97), 422 (4.03)
IR ($CDCl_3$) [105]: 3500, 2950, 1730, 1630
Mass [105]: 406 (52) $[M]^+$, 351 (29), 349 (100), 294 (28)
HRMS [105]: 406.1776 $[M]^+$
PMR (250 MHz, $CDCl_3$) [105]: 0.88 (3H, t, J = 7, $MeCH_2$), 1.12 (3H, d, J = 7, MeCH), 1.2-1.8 (2H, m, $MeCH_2CH$), 1.80 and 1.94 (6H, two s, Me_2C=CH), 3.52-3.84 (3H, m, $ArCH_2CH$ and CH_2CHCO), 5.4 (1H, t, J = 7, Me_2C=$CHCH_2$), 6.08 (1H, s, PhC=CHCO), 7.44-7.8 (5H, m, ArH), 10.1 (1H, s, OH), 11.2 (1H, s, OH)
Biol: inhibitor of oxidative phosphorylation at 0.5 µg/mL [106]

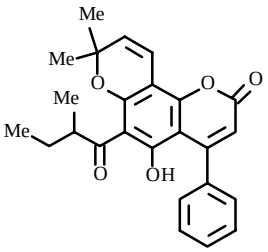


83. Mammea A/AB dioxalanocyclo F

Calophyllum dispar [67]
$C_{25}H_{24}O_7$
UV (EtOH) [67]: 230 (3.83), 281 (4.08), 346 (3.46); (EtOH+NaOH): 256 (4.00), 281 (3.98), 338 (3.34), 416 (3.56)
IR ($CHCl_3$) [67]: 3440, 1717, 1617, 1559, 768, 702
Mass [67]: 436 (41), 403 (25), 389 (57), 379 (61), 378 (41), 363 (20), 347 (37), 321 (90), 305 (45), 171 (30), 43 (100)
HREIMS [67]: 436.1528 $[M]^+$
PMR (500 MHz, $CDCl_3$) [67]: 0.91 (3H, t, J = 7.0, CH_3-5″), 1.17 (3H, d, J = 7.0, CH_3-3″), 1.43 (1H, m, CH_2-4a″), 1.48 (3H, s, CH_3-4‴), 1.50 (3H, s, CH_3-5‴), 1.79 (1H, m, CH_2-4b″), 3.58 (1H, m, H-2″), 5.48 (1H, d, J = 6.0, H-2‴), 6.01 (1H, s, H-3), 6.22 (1H, d, J = 6.0, H-1‴), 7.30 (2H, m, H-2′, H-6′), 7.42 (3H, m, H-3′, H-4′, H-5′), 14.96 (1H, s, OH-5)
HMBC [67]

^{13}C NMR (125 MHz, $CDCl_3$) [67]:

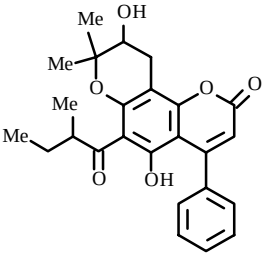
C-2	158.8	C-8	102.9	C-5′	127.7	C-5″	11.9
3	113.1	8a	156.2	6′	127.2	1‴	81.8
4	157.1	1′	139.0	1″	209.3	2‴	99.4
4a	102.4	2′	127.2	2″	45.7	3‴	85.7
5	166.5	3′	127.7	3″	16.7	4‴	18.4
6	103.2	4′	128.3	4″	26.5	5‴	23.6
7	164.6						



84. Mammea A/AB cyclo D (MAB 5)

Mammea africana [98, 99], *Kielmeyera lathrophyton* [111]
$C_{25}H_{24}O_5$, **mp** 78-80°C [99], 84-87°C [5], 89.5-92°C [112]
UV (MeOH) [111]: 232, 285, 345; (MeOH+0.1 N HCl) [99]: 233 (4.36), 286 (4.46), 335 (4.76); (MeOH+0.1 N NaOH): 250 (4.30), 310 (4.31), 430 (3.69)
IR ($CHCl_3$) [111]: 3448, 1748, 1650, 1582, 1132, 1115, 699
Mass [111]: 404 (44) $[M]^+$, 389 (100), 347 (86)
PMR (300 MHz, $CDCl_3$) [5]: 0.91 (3H, t, J = 7.4, $MeCH_2CH$), 1.17 (3H, d, J = 7.0, MeCHCO), 1.34-1.50 (1H, m, $MeCH_2CH$), 1.58 (3H, s, Me_2CH), 1.59 (3H, s, Me_2CH), 1.77-1.92 (1H, m, $MeCH_2CH$), 3.66-3.78 (1H, m, J = 7.0, MeCHCO), 5.64 (1H, d, J = 10.1, ArCH=CH), 6.00 (1H, s, C=CHCO), 6.91 (1H, d, J = 10.1, ArCH=CH), 7.30-7.45 (5H, m, Ph), 14.70 (1H, s, OH)
^{13}C NMR (75 MHz, $CDCl_3$) [111]:

C-2	159.5	C-8	101.4	C-1″	211.3	C-1‴	139.0
3	112.5	8a	157.7	2″	46.5	2‴	127.0
4	154.6	4′	115.4	3″	26.5	3‴	127.5
4a	102.1	5′	126.2	4″	11.7	4‴	128.1
5	164.3	6′	79.7	5″	16.5	5‴	127.5
6	106.8	7′	28.0			6‴	127.0
7	156.3	8′	28.0				

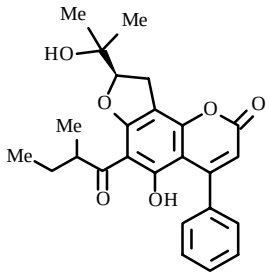


85. Mammea A/AB cyclo E

Calophyllum dispar [67]
$C_{25}H_{26}O_6$
UV (EtOH) [67]: 235 (4.11), 282 (4.37), 344 (3.94); (EtOH+NaOH): 254 (4.22), 282 (4.09), 313 (4.01), 426 (3.92)
IR ($CHCl_3$) [67]: 3400, 1717, 1617, 1561, 768, 704
Mass [67]: 422 (75), 420 (20), 405 (10), 389 (13), 365 (94), 363 (50), 347 (40), 335 (12), 321 (14), 307 (33), 305 (20), 293 (100)
HREIMS [67]: 422.1747 $[M]^+$
PMR (500 MHz, $CDCl_3$) [67]: 0.93 (3H, t, J = 7.0, CH_3-5″), 1.16 (3H, d, J = 6.5, CH_3-3″), 1.36 (6H, s, CH_3-4‴, CH_3-5‴), 1.41 (1H, m, CH_2-4a″), 1.81 (1H, m, CH_2-4b″), 3.35 (2H, m, CH_2-1‴), 3.64 (1H, m, H-2″), 5.25 (1H, d, J = 8.5, H-2‴), 5.96 (1H, s, H-3), 7.33 (m, 2H, H-2′, H-6′), 7.41 (m, 3H, H-3′, H-4′, H-5′), 14.67 (s, 1H, OH-7)
HMBC [67]

^{13}C NMR (125 MHz, $CDCl_3$) [67]:

C-2	159.8	C-8	104.6	C-5′	127.6	C-5″	11.7
3	112.0	8a	155.5	6′	127.2	1‴	27.1
4	156.7	1′	139.1	1″	209.6	2‴	89.0
4a	102.5	2′	127.2	2″	45.6	3‴	83.0
5	165.0	3′	127.6	3″	16.5	4‴	19.9
6	102.8	4′	128.2	4″	26.4	5‴	20.5
7	163.9						

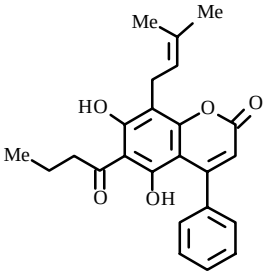


86. Mammea A/AB cyclo F (MAB 3)

Mammea americana [113, 114], *M. africana* [98, 99],
Kielmeyera pumila [110], *Calophyllum dispar* [66]
$C_{25}H_{26}O_6$, **mp** 115-117°C [114], 134°C [99], 140-142°C [105]
UV (EtOH) [105]: 281, 350; (EtOH+KOH): 246, 315
IR ($CDCl_3$) [105]: 2950, 1720, 1600
Mass [105]: 422 (100) $[M]^+$, 365 (72), 364 (12), 363 (14), 347 (23), 307 (10), 293 (72)
PMR (250 MHz, $CDCl_3$) [105]: 0.88 (3H, t, J = 7, $MeCH_2$), 1.12 (3H, dd, J = 7, J = 2, MeCH), 1.28 and 1.38 (6H, two s, Me_2CCH), 1.2-1.9 (2H, m, $MeCH_2CH$), 1.80 (1H, s, Me_2COH), 3.24 (2H, d, J = 9, $ArCH_2CH$), 3.54 (1H, m, CH_2CHCO), 4.82 (1H, t, J = 9, Me_2CCHCH_2), 5.80 (1H, s, PhC=CHCO), 7.0-7.4 (5H, m, ArH), 14.28 (1H, s, OH)
^{13}C NMR (67.5 MHz, $CDCl_3$) [66]:

C-2	159.8	C-8	92.9	C-3′	127.5	C-3″	16.1
3	111.5	9	26.5	4′	128.1	4″	26.0
4	156.7	9a	105.2	5′	127.5	5″	11.7
4a	102.1	9b	155.3	6′	127.1	1‴	71.3
5	164.7	1′	138.8	1″	209.5	2‴	26.2
6	102.7	2′	127.1	2″	45.5	3‴	24.9
6a	163.9						

Biol: cytotoxic activity against cell line KB at ED_{50} 5 µg/mL [66]

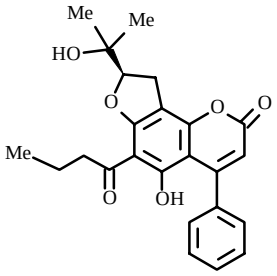


87. Mammea A/AC

Ochrocarpus siamensis [117], *Mesua racemosa* [101]
$C_{24}H_{24}O_5$, **mp** 116-117°C [117]
UV (95% EtOH) [117]: 235 (4.11), 280 (4.21), 335 (3.71)
IR (mineral oil) [117]: 3340, 1700, 1620, 1580
Mass [117]: 392 (90) $[M]^+$, 377 (16), 349 (66), 337 (100)
PMR (60 MHz, $CDCl_3$) [117]: 0.93 (t, J = 7, 3H), 1.38-1.95 (2H, m), 1.76 (d, J = 0.5, 3H), 1.90 (d, J = 0.5, 3H), 2.98 (t, J = 7, 2H), 3.57 (t, J = 7.5, 2H), 5.31 (t, J = 7.5, 1H), 5.96 (s, 1H), 7.52 (s, 5H), 9.72 (s, 1H), 11.15 (s, 1H)

^{13}C NMR (67.5 MHz, $CDCl_3$) [101]:

C-2	159.2	C-7	156.6	C-4′	129.7	C-4″	13.7
3	112.7	8	107.5	5′	129.1	1‴	21.7
4	159.5	8a	163.3	6′	127.4	2‴	120.6
4a	101.3	1′	137.2	1″	207.4	3‴	135.4
5	154.4	2′	127.4	2″	46.8	4‴	18.0
6	107.9	3′	129.1	3″	17.6	5‴	25.8

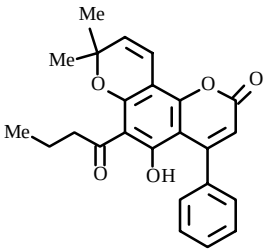


88. Mammea A/AC cyclo F

Mammea americana [114], *Mesua racemosa* [101], *Calophyllum dispar* [66]
$C_{24}H_{24}O_6$, **mp** 119°C [101]
$[\alpha]_D$ -2.6° ($CHCl_3$) [101]
UV (EtOH) [101]: 230 (3.76), 279 (4.03), 349 (3.64)
IR (KBr) [101]: 3566, 1734, 1704, 1614
Mass [101]: 409 (23), 408 (100) $[M]^+$, 375 (14), 365 (40), 351 (12), 350 (54), 349 (48), 337 (19), 322 (25), 321 (25), 307 (50), 305 (12), 294 (14), 293 (50), 279 (12), 105 (11), 59 (22), 43 (21)
HREIMS [101]: 408.1591
PMR (270 MHz, $CDCl_3$) [101]: 0.99 (3H, t, J = 7.5, CH_3-4″), 1.32 (3H, s, CH_3-2‴), 1.44 (3H, s, CH_3-3‴), 1.68 (2H, m, CH_2-3″), 3.00 (2H, m, CH_2-2″), 3.32 (2H, dd, J = 6.0, J = 3.0, CH_2-9), 4.92 (1H, t, J = 9.0, H-8), 5.95 (1H, s, H-3), 7.30 (2H, m, H-2′, H-6′), 7.40 (3H, m, H-3′, H-4′, H-5′), 14.39 (1H, s, OH-5)
HMBC, HMQC [101]
^{13}C NMR (67.5 MHz, $CDCl_3$) [101]:

C-2	159.7	C-6a	164.3	C-2′	127.2	C-2″	45.2
3	112.1	8	92.8	3′	127.6	3″	17.9
4	156.5	9	26.8	4′	128.3	4″	13.8
4a	102.2	9a	105.1	5′	127.6	1‴	71.6
5	163.8	9b	155.3	6′	127.2	2‴	24.8
6	103.0	1′	139.1	1″	205.4	3‴	26.2

Biol: cytotoxic activity against cell line KB at ED_{50} 6 µg/mL [66]

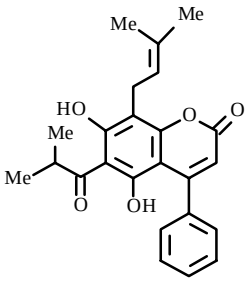


89. Mammea A/AC cyclo D (6-butyryl-5-hydroxy-4-phenylseselin)

Ochrocarpus siamensis [117], *Mesua racemosa* [101], *Mammea siamensis* [118]
$C_{24}H_{22}O_5$, **mp** 138-139°C [117]
UV (EtOH) [117]: 232 (4.60), 282 (4.68), 350 (3.97)
IR (mineral oil) [117]: 1725, 1630, 1600, 1575
Mass [117]: 390 (44) $[M]^+$, 375 (100), 357 (16), 347 (14)
PMR (60 MHz, $CDCl_3$) [117]: 0.98 (3H, t, J = 7.0), 1.43-1.90 (2H, m), 1.65 (6H, s), 3.98 (2H, t, J = 7.0), 5.65 (1H, d, J = 10.0), 6.01 (1H, s), 6.94 (1H, d, J = 10.0), 7.40 (5H, s), 14.73 (1H, s)

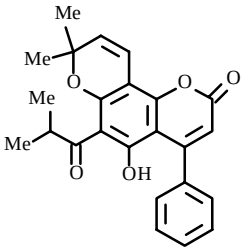
^{13}C NMR (67.5 MHz, $CDCl_3$) [101]:

C-2	160.1	C-6a	155.2	C-1′	139.7	C-1″	207.5
3	113.1	8	80.3	2′	127.6	2″	47.3
4	156.8	9	116.0	3′	128.1	3″	18.7
4a	102.6	10	126.8	4′	128.7	4″	14.3
5	164.8	10a	101.9	5′	128.1	1‴	28.7
6	107.4	10b	158.7	6′	127.6	2‴	28.7



90. Mammea A/AD (mesuol)

Mesua ferrea [104], *M. thwaitesii* [102], *Mammea americana* [119], *M. africana* [6, 104]
$C_{24}H_{24}O_5$, **mp** 146-148°C [105], 154°C [119], 183-184°C [104]
$[\alpha]_D$ +66° [104]
UV (EtOH+KOH) [119]: 234 (4.33), 303 (4.21), 394 (3.84), 426 (4.03)
IR ($CDCl_3$) [105]: 3450, 1730, 1630
Mass [105]: 392 (35) $[M]^+$, 349 (75), 337 (18), 293 (100)
HRMS [105]: 392.1614 $[M]^+$
PMR (250 MHz, $CDCl_3$) [105]: 1.10 (6H, d, J = 7, Me_2CH), 1.74 and 1.88 (6H, two s, Me_2C=CH), 3.54 (2H, d, J = 7, $ArCH_2CH$), 3.72 (1H, m, J = 7, Me_2CHCO), 5.22 (1H, t, J = 7, Me_2C=$CHCH_2$), 5.90 (1H, s, PhC=CHCO), 7.2-7.5 (5H, m, ArH), 9.84 (1H, s, OH), 10.90 (1H, s, OH)

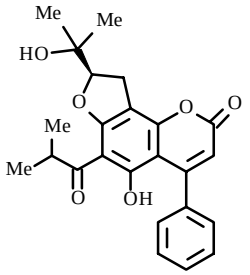


91. Mammea A/AD cyclo D (mesuagin)

Mesua ferrea [109], *M. thwaitesii* [102], *M. racemosa* [101], *Mammea americana* [6]
$C_{24}H_{22}O_5$, **mp** 151-153°C [104], 152-153°C [109]
UV [109]: 235 (4.31), 285-286 (4.40), 362 (3.79)
IR (KBr) [109]: 3400, 1739, 1653, 1613, 1378, 709
PMR ($CDCl_3$) [109]: 1.25 (6H, d), 1.58 (6H, s), 3.73 (1H, m), 5.62 (1H, d), 5.97 (1H, s), 6.88 (1H, d), 7.33 (5H, m), 14.63 (1H, s)
^{13}C NMR (67.5 MHz, $CDCl_3$) [101]:

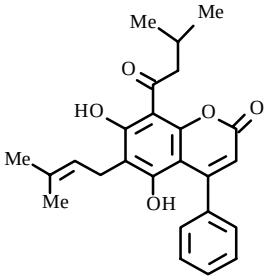
C-2	159.7	C-6a	154.8	C-1′	139.3	C-1″	211.5
3	112.7	8	79.9	2′	127.2	2″	39.9
4	156.5	9	115.5	3′	127.7	3a″	19.3
4a	102.6	10	126.3	4′	128.3	3b″	19.3
5	164.6	10a	101.5	5′	127.7	1‴	28.2
6	106.4	10b	157.8	6′	127.2	2‴	28.2

Biol: antibacterial activity against *Staphyllococcus aureus* [109]



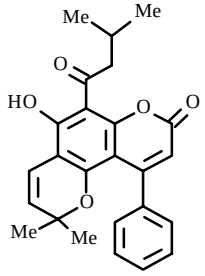
92. Mammea A/AD cyclo F

Mammea americana [114]
$C_{24}H_{24}O_6$



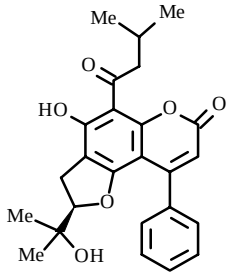
93. Mammea A/BA

Mammea americana [115, 116], *M. africana* [116]
$C_{25}H_{26}O_5$, **mp** 125-126°C [115]
UV (EtOH) [116]: 227 (4.43), 234 (4.43), 270 (4.17), 297 (4.24), 335 (4.37); (EtOH+HCl): 225 (4.46), 294 (4.36), 332 (4.25); (EtOH+KOH): 233 (4.40), 261 (4.19), 337 (4.60)
IR [116]: 3480, 1723, 1610, 1595
Mass [116]: 406 $[M]^+$, 363, 351, 349, 293, 265
PMR [116]: 1.04 (6H, d, J = 7.0, two CH_3-3′), 1.63 (3H, s, CH_3-3″), 1.68 (3H, s, CH_3-3″), 2.2 (1H, m, H-3′), 3.08 (2H, d, J = 7.0, CH_2-2′), 3.19 (2H, d, J = 7.0, CH_2-1″), 5.03 (1H, m, H-2′), 5.79 (1H, s, H-3), 5.90 (1H, s, OH-5), 7.43 (5H, s, Ph-4), 14.53 (1H, s, OH-7)
Biol: inhibitor of oxidative phosphorylation at 0.5 µg/mL [106]



94. Mammea A/BA cyclo D (isomammeigin)

Kielmeyera pumila [110]
$C_{25}H_{24}O_5$, **mp** 173-175°C [110]
UV (EtOH) [110]: 265 (3.39), 273 (4.39), 314 (4.35), 373 (3.66); (EtOH+NaOH): 230 (4.25), 252 (4.36), 312 (4.41); (EtOH+NaOAc): 240 (4.29), 305 (4.32)
IR (KBr) [110]: 3400, 2920, 1745, 1635, 1605, 1580, 1550, 1380, 1190, 1175, 1150, 1135, 910, 870, 790, 755, 700
Mass [110]: 404 (22) $[M]^+$, 389 (100), 371 (11), 347 (10)
PMR (100 MHz, $CDCl_3$) [110]: 0.96 (6H, s, two Me-2), 1.07 (6H, d, J = 7.0, two Me-3′), 2.29 (1H, m, CH-3′), 3.18 (2H, d, J = 7.0, CH_2-2′), 5.37 (1H, d, J = 10.0, H-3), 5.98 (1H, s, H-9), 6.60 (1H, d, J = 10.0, H-4), 7.28 (5H, s, Ph-10), 12.27 (1H, s, OH-5)



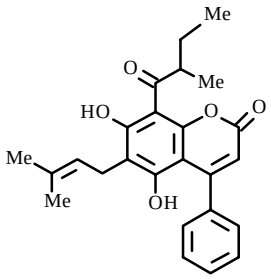
95. Mammea A/BA cyclo f

Calophyllum dispar [66]
$C_{25}H_{24}O_5$, **mp** 113-115°C [66]
UV (EtOH) [66]: 226 (4.10), 234 (4.10), 300 (4.11), 327 (3.87); (EtOH+NaOH): 252 (4.10), 283 (3.7), 389 (3.97)
IR ($CHCl_3$) [66]: 3470, 1725, 1605, 1561, 756, 702
HRFABMS [66]: 421.1674 $[M - H]^-$
PMR (270 MHz, $CDCl_3$) [66]: 0.94 (s, 3H, CH_3-6″), 1.02 (s, 3H, CH_3-5″), 1.08 (d, J = 6.5, 6H, CH_3-4‴, CH_3-5‴), 2.32 (m, 1H, H-3‴), 2.93 (dd, J = 8.5, J = 15.5, 1H, CH_2-3″β), 3.08 (dd, J = 10.0, J = 15.5, 1H, CH_2-3‴α), 3.19 (d, J = 7.0, 2H, CH_2-2‴), 4.52 (t, J = 9.0, 1H, H-2″), 6.08 (s, 1H, H-3), 7.32 (m, 2H, H-2′,

H-6′), 7.44 (m, 3H, H-3′, H-4′, H-5′), 14.33 (s, 1H, OH-7)
DQF-COSY, HMQC, HMBC, NOESY [66]
^{13}C NMR (67.5 MHz, $CDCl_3$) [66]:

C-2	159.1	C-9	157.3	C-5′	127.9	C-6″	24.8
3	111.0	10	98.6	6′	127.4	1‴	206.1
4	154.9	1′	138.0	2″	92.7	2‴	53.4
5	161.9	2′	127.4	3″	26.8	3‴	25.6
6	110.0	3′	127.9	4″	71.6	4‴	22.7
7	163.7	4′	128.8	5″	23.2	5‴	22.7
8	105.0						

Biol: cytotoxic activity against cell line KB at ED_{50} 9 µg/mL [66]

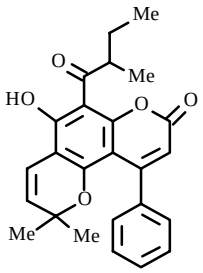


96. Mammea A/BB

Mammea americana [115, 116], *Mesua racemosa* [101]
$C_{25}H_{26}O_5$, **mp** 124-125°C [116]
UV (EtOH) [116]: 235 (4.43), 295 (4.28), 335 (4.31); (EtOH+HCl): 227 (4.45), 294 (4.38), 333 (4.24); (EtOH+KOH): 234 (4.39), 263 (4.19), 337 (4.58)
IR [116]: 3485, 1725, 1615, 1600, 1555
Mass [116]: 406 $[M]^+$, 363, 351, 349, 293
PMR [116]: 1.02 (t, J = 7.0, 3H, CH_3-4′), 1.26 (d, J = 7.0, 3H, CH_3-2′), 1.60 (m, 2H, CH_2-3′), 1.64 (s, 3H, CH_3-3″), 1.70 (s, 3H, CH_3-3″), 3.20 (d, J = 7.0, 2H, CH_2-1″), 3.87 (m, 1H, H-2′), 5.10 (m, 1H, H-2″), 5.82 (s, 2H, OH-5, H-3), 7.46 (s, 5H, Ph-4), 14.51 (s, 1H, OH-7)
^{13}C NMR (67.5 MHz, $CDCl_3$) [101]:

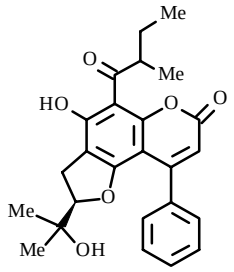
C-2	159.2	C-8	104.1	C-5′	129.5	C-5″	25.6
3	112.1	8a	155.7	6′	127.5	1‴	210.1
4	154.1	1′	136.8	1″	21.6	2‴	47.0
4a	100.5	2′	127.5	2″	120.8	2a‴	16.6
5	157.0	3′	129.5	3″	134.1	3‴	27.2
6	112.6	4′	130.2	4″	17.9	4‴	11.8
7	166.9						

Biol: inhibitor of oxidative phosphorylation at 0.5 µg/mL [106]



97. Mammea A/BB cyclo D (ponnalide)

Mammea americana [105], *Calophyllum inophyllum* [87]
$C_{25}H_{24}O_5$, **mp** 126-127°C [5], 127-129°C [105]
UV (EtOH) [105]: 263, 271, 311, 385; (EtOH+KOH): 263, 323, 402
IR ($CDCl_3$) [105]: 1730, 1640, 1600
PMR (250 MHz, $CDCl_3$) [105]: 1.0 (6H, s, Me_2C), 1.04 (3H, t, J = 7, $MeCH_2$), 1.32 (3H, d, J = 7, MeCH), 1.3-2.1 (2H, m, $MeCH_2CH$), 4.0 (1H, m, CH_2CHCO), 5.52 (1H, d, J = 11, ArCH=CH), 6.16 (1H, s, PhC=CHCO), 6.76 (1H, d, J = 11, ArCH=CH), 7.3-7.6 (5H, m, ArH), 14.90 (1H, s, OH)



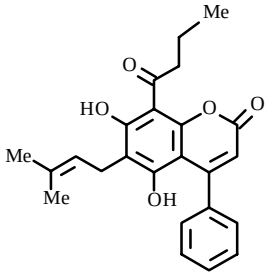
98. Mammea A/BB cyclo F

Calophyllum dispar [66]
$C_{25}H_{24}O_5$
UV (EtOH) [66]: 227 (4.21), 235 (4.19), 299 (4.22), 325 (4.02); (EtOH+NaOH): 252 (4.24), 283 (3.90), 389 (4.07)
IR ($CHCl_3$) [66]: 3460, 1732, 1607, 1559, 758, 704
HRFABMS [66]: 421.1639 $[M - H]^-$

PMR (270 MHz, $CDCl_3$) [66]: 0.94 (3H, s, CH_3-6″), 1.01 (3H, t, J = 7.0, CH_3-5‴), 1.02 (3H, s, CH_3-5″), 1.28 (3H, d, J = 7.0, CH_3-3‴), 1.50 (1H, m, CH_2-4‴a), 1.94 (1H, m, CH_2-4‴b), 2.93 (1H, dd, J = 8.0, J = 15.0, CH_2-3″*β*), 3.07 (1H, dd, J = 10.0, J = 15.0, CH_2-3″*α*), 3.96 (1H, m, H-2‴), 4.52 (1H, t, J = 9.0, H-2″), 6.07 (1H, s, H-3), 7.32 (2H, m, H-2′, H-6′), 7.44 (3H, m, H-3′, H-4′, H-5′), 14.32 (1H, s, OH-7)
^{13}C NMR (67.5 MHz, $CDCl_3$) [66]:

C-2	159.1	C-9	157.1	C-5′	127.9	C-6″	24.8
3	111.0	10	98.7	6′	127.4	1‴	210.4
4	154.9	1′	138.1	2″	92.6	2‴	46.7
5	161.8	2′	127.4	3″	26.6	3‴	16.5
6	110.1	3′	127.9	4″	71.6	4‴	27.1
7	163.9	4′	128.8	5″	23.2	5‴	11.8
8	104.5						

Biol: cytotoxic activity against cell line KB at ED_{50} 15 µg/mL [64]

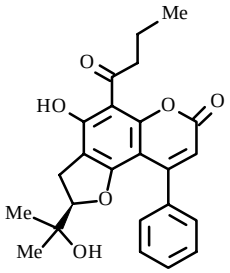


99. Mammea A/BC

Mesua racemosa [72]
$C_{24}H_{24}O_5$, **mp** 123-124°C [72]
UV (EtOH+HCl) [72]: 225 (4.09), 294 (4.03), 331 (3.85); (EtOH+NaOH): 235 (4.21), 334 (4.17), 384 (3.73)
IR [72]: 3486, 1742, 1705, 1616, 1595, 1389, 1132, 769, 704
HRLSIMS [72]: 391.1526 $[M - H]^+$

PMR (270 MHz, $CDCl_3$) [72]: 1.03 (3H, t, J = 7.0, CH_3-4‴), 1.66 (3H, s, CH_3-4″), 1.71 (3H, s, CH_3-5″), 1.83 (2H, m, CH_2-3‴), 3.30 (2H, m, CH_2-2‴), 3.33 (2H, m, CH_2-1″), 5.09 (1H, t, J = 1.0, H-2″), 5.96 (1H, s, OH-5), 6.01 (1H, s, H-3), 7.44 (2H, m, H-2′, H-6′), 7.57 (3H, m, H-3′, H-4′, H-5′), 14.58 (1H, s, OH-7).
HMBC [72]
^{13}C NMR (67.5 MHz, $CDCl_3$) [72]:

C-2	158.7	C-7	166.7	C-4′	130.2	C-4″	25.7
3	112.5	8	104.5	5′	129.6	5″	17.9
4	154.1	8a	156.0	6′	127.5	1‴	206.3
4a	100.4	1′	136.8	1″	21.5	2‴	46.7
5	157.0	2′	127.5	2″	120.8	3‴	18.1
6	112.1	3′	129.6	3″	134.1	4‴	13.8

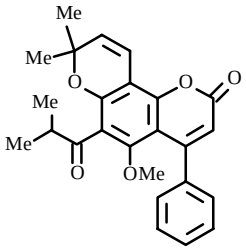


100. Mammea A/BC cyclo F

Calophyllum dispar [66]
$C_{24}H_{24}O_6$
UV (EtOH) [66]: 227 (4.30), 235 (4.28), 299 (4.31), 331 (4.03); (EtOH+NaOH): 253 (4.32), 282 (3.92), 389 (4.18)
IR ($CHCl_3$) [66]: 3460, 1732, 1607, 1559, 758, 704
HRFABMS [66]: 407.525 $[M - H]^-$

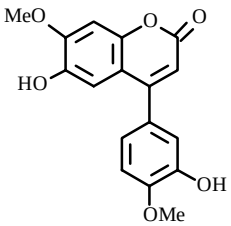
PMR (270 MHz, $CDCl_3$) [66]: 0.94 (3H, s, CH_3-6″), 1.01 (3H, t, J = 7.0, CH_3-5‴), 1.02 (3H, s, CH_3-5″), 1.28 (3H, d, J = 7.0, CH_3-3‴), 1.50 (1H, m, CH_2-4‴a), 1.94 (1H, m, CH_2-4‴b), 2.93 (1H, dd, J = 8.0, J = 15.0, CH_2-3″*β*), 3.08 (1H, dd, J = 10.0, J = 15.0, CH_2-3‴*α*), 3.96 (1H, m, H-2‴), 4.52 (1H, t, J = 9.0, H-2″), 6.07 (1H, s, H-3), 7.32 (2H, m, H-2′, H-6′), 7.44 (3H, m, H-3′, H-4′, H-5′), 14.33 (1H, s, OH-7)
^{13}C NMR (67.5 MHz, $CDCl_3$) [66]:

C-2	159.1	C-9	157.1	C-5′	127.9	C-6″	24.8
3	111.0	10	98.7	6′	127.4	1‴	210.4
4	154.9	1′	138.1	2″	92.6	2‴	46.7
5	161.8	2′	127.4	3″	26.6	3‴	16.5
6	110.1	3′	127.9	4″	71.6	4‴	27.1
7	163.9	4′	128.8	5″	23.2	5‴	11.8
8	104.5						



101. Mesuarin

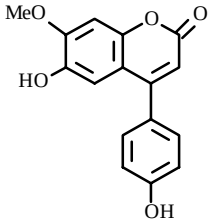
Mesua ferrea [120]
$C_{25}H_{24}O_5$, **mp** 130°C [120]
UV (EtOH) [120]: 233 (4.63), 282 (4.35), 360 (4.1)
IR (KBr) [120]: 1740, 1710, 1600, 1500, 1200, 700
Mass [120]: 420 $[M]^+$, 405, 377
PMR (90 MHz, DMSO-d_6) [120]: 1.35 (6H, d, J = 10.0, two Me-2′), 1.55 (s, 6H, two Me-8), 3.01 (s, 3H, OMe-5), 3.72 (1H, m, H-2′), 5.65 (1H, d, J = 10.0, H-9), 6.0 (s, 1H, H-3), 6.50 (1H, d, J = 10.0, H-10), 7.30 (m, 5H, Ph-4)
Biol: antibacterial activity against *Bacillus firmis* [120]



102. Melanein

Dalbergia baroni [52, 53], *D. melanoxylon* [43, 121]
$C_{17}H_{14}O_6$, **mp** 220.5-222°C [43], 221-223°C [52, 53]
UV (EtOH) [53]: 234 (4.38), 256 (4.17), 308 (4.0), 344 (4.09)
IR (KBr) [53]: 3289, 2950, 1664, 1616, 1274, 1244, 1174, 1138, 1026, 817
Mass [53]: 299, 286, 271, 243

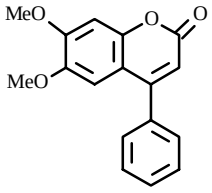
PMR (60 MHz, DMSO-d_6) [53]: 2.5 (1H, s, OH), 3.2 (1H, s, OH), 3.85 (3H, s, OMe), 3.88 (3H, s, OMe), 6.1 (1H, s, H-3), 6.9-7.18 (5H, m)



103. Melanetin

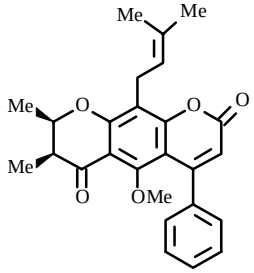
Dalbergia melanoxylon [122], *D. odorifera* [30, 31]
$C_{16}H_{12}O_5$, **mp** 233-234°C [123], 236-237°C [124]
UV (EtOH) [123]: 230 (4.50), 263 (4.09), 312 (4.27), 350 (4.21)
IR (KBr) [123]: 3430, 1660
^{13}C NMR (75.4 MHz, DMSO-d_6) [30]:

C-2	160.39	C-6	143.34	C-10	111.06	C-4′	158.67
3	110.28	7	151.67	1′	125.76	5′	115.48
4	155.03	8	100.43	2′	129.76	6′	129.76
5	110.62	9	148.33	3′	115.48	7-OMe	56.04



104. O-Methyldalbergin

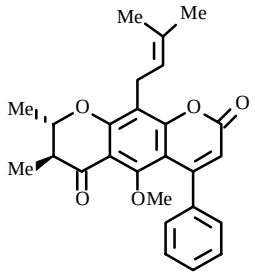
Dalbergia latifolia [42], *D. nigra* [44], *D. sissoo* [125],
Machaerium scleroxylon [57], *M. pedicellatum* [58], *Prosopis kuntzei* [60],
Goniorrhachis marginata [61]
$C_{17}H_{14}O_4$, **mp** 145-146°C [40], 146-147°C [16]
IR (KBr) [54]: 1727; ($CHCl_3$): 1709
Mass [126]: 282 (100) $[M]^+$, 254 (29.5), 239 (21.5), 224 (12.5), 211 (4.2), 152 (6.6)



105. O-methylisocalaustralin

Calophyllum teysmanii var. *inophyllolide* [14]
$C_{26}H_{26}O_5$
$[\alpha]_D$ -10.8° ($CHCl_3$) [14]
UV (EtOH) [14]: 232, 272, 324
IR (KBr) [14]: 1743, 1695, 1578, 1384, 1327, 1156, 1108, 864, 768, 698
Mass [14]: 418 (86) $[M]^+$, 403 (80), 363 (70), 349 (80), 319 (90), 307 (80)
HREIMS [14]: 418.1763 $[M]^+$
PMR (300 MHz, $CDCl_3$) [14]: 1.13 (3H, d, J = 7.2, CH_3-16), 1.41 (3H, d, J = 6.6, CH_3-17), 1.71 (3H, s, CH_3-15), 1.87 (3H, s, CH_3-14), 2.67 (1H, dq, J = 3.5, J = 7.2, H-7), 3.10 (3H, s, OMe-5), 3.54 (2H, d, J = 7.5, CH_2-11), 4.69 (1H, dq, J = 3.5, J = 6.6, H-8), 5.26 (1H, m, J = 7.5, H-12), 6.06 (1H, s, H-3), 7.32-7.39 (5H, m, Ph)
NOE, HMQC, HMBC [14]
^{13}C NMR (75 MHz, $CDCl_3$) [14]:

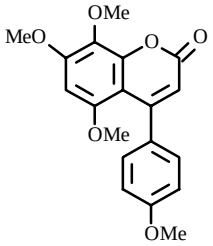
C-2	159.5	C-7	46.1	C-13	133.1	C-2′	127.5
3	114.2	8	76.5	14	25.9	3′	127.6
4	156.6	9	158.6	15	18.1	4′	128.1
4a	108.5	10	115.1	16	9.2	5′	127.6
5	161.5	10a	155.6	17	16.0	6′	127.5
5a	111.0	11	22.2	1′	139.0	OMe	62.5
6	193.6	12	120.8				



106. O-Methylcalaustralin

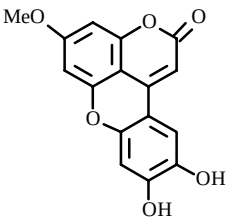
Calophyllum teysmannii var. *inophyllolide* [14]
$C_{26}H_{26}O_5$
$[\alpha]_D$ -18° ($CHCl_3$) [14]
UV (EtOH) [14]: 232, 268, 324, 346
IR (KBr) [14]: 1741, 1691, 1577, 1460, 1409, 1384, 1324, 1260, 1124, 1039, 904, 860, 769, 702
Mass [14]: 418 (70) $[M]^+$, 403 (70), 363 (40), 349 (65), 319 (90), 307 (60)
HREIMS [14]: 418.1807 $[M]^+$
PMR (300 MHz, $CDCl_3$) [14]: 1.18 (3H, d, J = 7.1, CH_3-16), 1.55 (3H, d, J = 6.3, CH_3-17), 1.71 (3H, s, CH_3-15), 1.88 (3H, s, CH_3-14), 2.55 (1H, dq, J = 12.0, J = 7.1, H-7), 3.10 (3H, s, OMe-5), 3.54 (2H, d, J = 7.3, CH_2-11), 4.27 (1H, dq, J = 12.0, J = 6.3, H-8), 5.27 (1H, m, J = 7.3, H-12), 6.07 (1H, s, H-3), 7.30-7.39 (5H, m, Ph)
NOE, HMQC, HMBC [14]
^{13}C NMR (75 MHz, $CDCl_3$) [14]:

C-2	159.4	C-7	47.4	C-13	132.9	C-2′	127.4
3	114.0	8	78.7	14	25.7	3′	127.4
4	156.4	9	158.2	15	17.9	4′	128.1
4a	108.3	10	115.0	16	10.4	5′	127.4
5	161.6	10a	155.5	17	19.5	6′	127.4
5a	111.5	11	22.0	1′	138.8	OMe	62.5
6	192.1	12	120.7				



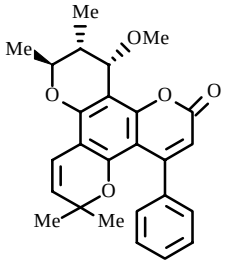
107. 8-O-Methylexostemin

Coutarea hexandra [25], *Exostema mexicanum* [26]
$C_{19}H_{18}O_6$, **mp** 143-145°C [127]
IR (KBr) [127]: 1722
PMR (200 MHz, $CDCl_3$) [127]: 3.35 (3H, s, OMe-5), 3.91 (3H, s, OMe-4′), 3.95 (3H, s, OMe-8), 3.97 (3H, s, OMe-7), 5.80 (1H, s, H-3), 6.34 (1H, s, H-6), 6.92 (2H, d, J = 8.5, H-3′, H-5′), 7.24 (2H, d, J = 8.5, H-2′, H-6′)
Biol: inhibitor of adenosine-3′,5′-cyclomonophosphate-phosphodiesterase at $IC_{50} = 13.3\times10^{-5}$ M [34], antiplasmodial activity against *Plasmodium falciparum* [26]



108. 7-Methoxy-4′,5′-dihydroxy-4-phenyl-5,2′-oxidocoumarin

Exostema caribaeum [11], *Hintonia latiflora* [128]
$C_{16}H_{10}O_6$, **mp** 300°C (dec.) [11], 342°C (dec.) [19], 342-345°C [128]
UV (MeOH) [19]: 260, 310, 375, 390; (MeOH+$AlCl_3$) [19]: 275, 325, 406; (MeOH+$AlCl_3$+HCl) [19]: 260, 310, 375, 390
IR (KBr) [19]: 3450, 1700, 1640, 1525, 1480, 1313, 1250, 1180
Mass [128]: 298 (100) $[M]^+$, 270 (49), 242 (70)
PMR (DMSO-d_6) [128]: 3.86 (3H, s, 7-OMe), 6.07 (1H, s, H-3), 6.71 (1H, d, J = 2.2, H-8), 6.74 (1H, d, J = 2.2, H-6), 6.76 (1H, s, H-3′), 7.32 (1H, s, H-6′)
^{13}C NMR (DMSO-d_6) [128]: 56.02, 92.37, 95.97, 96.41, 99.72, 103.22, 106.13, 109.03, 141.17, 143.69, 146.44, 150.59, 152.25, 154.46, 160.91, 162.99

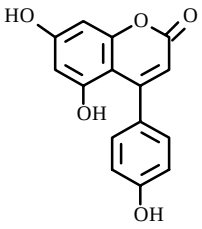


109. 12-Methoxyinophyllum P

Calophyllum teysmannii var. *inophylloide* [20]
$C_{26}H_{26}O_5$
$[\alpha]_D$ +25.5° ($CHCl_3$) [20]
UV [20]: 232, 278, 286, 334
IR [20]: 2983, 2914, 1725, 1630, 1570, 1560, 1455, 1382, 1127, 857, 750, 705, 683
Mass [20]: 418 (42) $[M]^+$, 403 (100), 388 (32), 372 (50), 347 (82)
HREIMS [20]: 418.1783 $[M]^+$
PMR (500 MHz, $CDCl_3$) [20]: 0.92 (3H, s, CH_3-14), 0.94 (3H, s, CH_3-13), 1.17 (3H, d, J = 6.7, H-16), 1.41 (3H, d, J = 6.3, H-15), 1.74 (1H, ddq, J = 2.8, J = 6.7, J = 11.0, H-11), 3.65 (3H, s, MeO), 4.32 (1H, dq, J = 6.3, J = 11.0, H-10), 4.62 (1H, d, J = 2.8, H-12), 5.34 (1H, d, J = 10.2, H-7), 5.95 (1H, s, H-3), 6.53 (1H, d, J = 10.2, H-8), 7.30 (2H, m, H-2′, H-6′), 7.40 (3H, m, H-3′, H-4′, H-5′)
^{13}C NMR (125 MHz, $CDCl_3$) [20]:

C-2	160.5	C-8	116.1	C-12b*	153.8	C-1′	140.2
3	111.7	8a	106.1	13	26.88	2′	127.5
4	156.2	8b*	153.5	14	26.93	3′	127.4
4a	102.7	10	73.5	15	19.1	4′	127.4
4b	151.2	11	38.6	16	13.3	5′	127.4
6	77.1	12	70.8			6′	127.5
7	127.4	12a	104.5			OMe	59.4

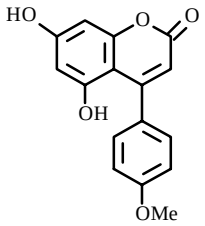
*Assignments may be reversed



110. Nivegin

Echinops niveus [129, 130]
$C_{15}H_{10}O_5$, **mp** 260°C [131], 262-264°C [130], 267-269°C [132], 293-294°C [27], 294-295°C [64]
UV (EtOH) [130]: 267 (4.14), 338 (4.20); (EtOH+NaOH): 278 (4.09), 400 (4.24)
IR (KBr) [130]: 3300, 1660, 1610, 1550, 1500, 1445, 1355, 1249, 1175, 825
HRMS [130]: 270.0528 (100) $[M]^+$, 242.0576 (18), 153 (22), 152 (15), 149 (24), 121 (15), 97 (10), 71 (15), 57 (28)
PMR (90 MHz, DMSO-d_6) [130]: 6.16 (1H, d, J = 2.12), 6.44 (1H, d, J = 2.12), 6.65 (1H, s), 6.89 (2H, d, J = 8.76), 7.86 (2H, d, J = 8.76)
^{13}C NMR (22.5 MHz, DMSO-d_6) [130]:

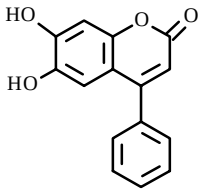
C-2	168.7	C-5	156.3	C-8a	162.1	C-4′	161.8
3	103.6	6	99.5	1′	122.2	5′	116.6
4	164.7	7	164.8	2′	129.0	6′	129.0
4a	104.5	8	94.6	3′	116.6		



111. Nivetin

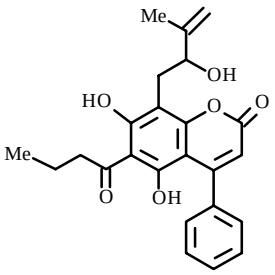
Echinops niveus [130]
$C_{16}H_{12}O_5$, **mp** 256-258°C [27], 263-265°C [64], 314-316°C (dec.) [130]
UV (MeOH) [130]: 270 (4.14), 335 (4.15); (MeOH+NaOH): 282 (4.08), 392 (4.16)
IR (KBr) [130]: 3100-3400, 2870, 1665, 1615, 1560, 1510, 1370, 1250, 1200, 848
Mass [130]: 284 (100) $[M]^+$, 270 (20), 269 (16), 256 (18), 153 (20), 152 (15), 149 (15), 121 (12), 48 (25)
PMR (90 MHz, DMSO-d_6) [130]: 3.85 (s, 3H), 6.17 (d, J = 2, 1H), 6.44 (d, J = 2, 1H), 6.66 (s, 1H), 6.96 (d, J = 8.7, 2H), 7.85 (d, J = 8.7, 2H)
^{13}C NMR (22.5 MHz, DMSO-d_6) [130]:

C-2	168.7	C-5	156.3	C-8a	162.1	C-4′	166.5
3	103.6	6	99.5	1′	122.3	5′	113.8
4	164.7	7	164.8	2′	128.5	6′	128.5
4a	104.5	8	94.6	3′	113.8	7-OMe	63.5



112. Nordalbergin

Dalbergia sissoo [125]
$C_{15}H_{10}O_4$, **mp** 260-261°C [133], 265°C [63], 268-269°C [40, 125], 274-276°C [134]
UV (EtOH) [63]: 262, 356; (EtOH+NaOH): 270, 360
IR (mineral oil) [63]: 3450, 3150, 1700, 1680
Mass [63]: 254, 226, 197, 181, 169, 152, 141, 127, 115, 102
PMR (60 MHz) [63]: 6.1 (1H, s), 6.82 (2H, d, J = 2), 7.53 (5H, m), 9.42 (2H, s)

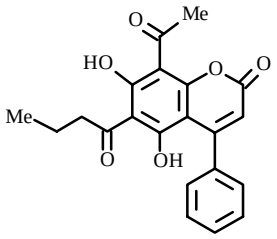


113. Racemosol

Mesua racemosa [101]
$C_{24}H_{24}O_6$, **mp** 140.8°C [101]
UV (EtOH) [101]: 237 (4.17), 284 (4.38), 339 (3.96)
IR (KBr) [101]: 3290, 1734, 1622, 1582
Mass [101]: 408 (14) $[M]^+$, 390 (13), 375 (15), 364 (21), 349 (16), 347 (17), 339 (11), 338 (41), 337 (100), 321 (24), 319 (24), 309 (14), 295 (22), 105 (13), 43 (25)
HREIMS [101]: 408.1591 $[M]^+$
PMR (270 MHz, $CDCl_3$) [101]: 0.98 (3H, t, J = 7.5, CH_3-4″), 1.70 (2H, m, CH_2-3″), 1.93 (3H, s, CH_3-5‴), 3.04 (1H, dd, J = 7.5, J = 15.0, CH_2-1b‴), 3.13 (2H, t, J = 7.5, CH_2-2″), 3.30 (1H, d, J = 13.5, CH_2-1a‴), 4.50 (1H, d, J = 7.5, H-2‴), 4.92 (1H, s, CH_2-4b‴), 5.03 (1H, s, CH_2-4a‴), 5.96 (1H, s, H-3), 7.32 (2H, m, H-2′, H-6′), 7.41 (3H, m, H-3′, H-4′, H-5′), 10.20 (1H, s, OH-7), 14.38 (1H, s, OH-5)
DQF-COSY, HMQC, HMBC [101]

^{13}C NMR (67.5 MHz, $CDCl_3$) [101]:

C-2	160.0	C-7	162.6	C-4′	128.3	C-4″	13.9
3	112.1	8	104.6	5′	127.7	1‴	28.7
4	156.7	8a	157.7	6′	127.2	2‴	77.2
4a	101.9	1′	139.3	1″	208.0	3‴	145.9
5	163.4	2′	127.2	2″	46.7	4‴	111.1
6	107.6	3′	127.7	3″	18.0	5‴	18.7



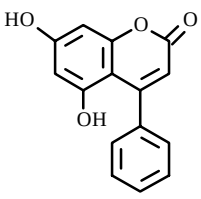
114. Racemosone

Mesua racemosa [72]
$C_{21}H_{18}O_6$, **mp** 149-150°C [72]
UV (EtOH+HCl) [72]: 216 (3.82), 269 (4.12), 325 (3.88); (EtOH+NaOH): 254 (4.00), 291 (4.01), 335 (3.94), 398 (3.76)
IR [72]: 3447, 1753, 1618, 1589, 1153, 769, 700
Mass [72]: 367 (9), 366 (40), 351 (6), 338 (20), 324 (21), 323 (100)
HREIMS [72]: 366.1100 $[M]^+$
PMR (270 MHz, $CDCl_3$) [72]: 0.98 (2H, t, J = 7.5, CH_3-4″), 1.72 (2H, m, CH_2-3″), 2.98 (3H, s, CH_3-2‴), 3.15 (2H, t, J = 7.5, CH_2-2″), 6.05 (1H, s, H-3), 7.30 (2H, m, H-2′, H-6′), 7.40 (3H, m, H-3′, H-4′, H-5′), 16.08 (1H, s, OH-5), 16.59 (1H, s, OH-7)
HMBC, DQF-COSY [72]:

C-2	158.1	C-7	172.1	C-3′	127.8	C-2″	46.6
3	112.3	8	102.7	4′	128.5	3″	17.7
4	156.6	8a	161.3	5′	127.8	4″	13.8
4a	101.5	1′	139.0	6′	126.9	1‴	204.0
5	170.4	2′	126.9	1″	208.2	2‴	33.6
6	106.1						

^{13}C NMR (67.5 MHz, $CDCl_3$) [72]:

C-2	160.0	C-7	162.6	C-4′	128.3	C-4″	13.9
3	112.1	8	104.6	5′	127.7	1‴	28.7
4	156.7	8a	157.7	6′	127.2	2‴	77.2
4a	101.9	1′	139.3	1″	208.0	3‴	145.9
5	163.4	2′	127.2	2″	46.7	4‴	111.1
6	107.6	3′	127.7	3′	18.0	5‴	18.7



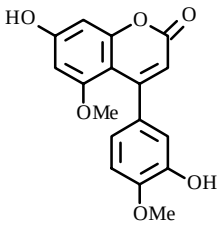
115. Serratin

Passiflora serratodigitata [36]
$C_{15}H_{10}O_4$, **mp** 213°C [36]
UV (MeOH) [36]: 208 (5.1), 254, 266 (3.9), 333 (3.91)
IR (KBr) [36]: 3170, 1660, 1600, 1585, 1545, 1450, 1370, 1155, 1070, 940, 850, 820, 770, 690
Mass [36]: 254 (100) $[M]^+$, 226 (95), 197 (47)

PMR (90 MHz, DMSO-d_6) [36]: 5.8 (1H, s, H-3), 6.25 (1H, d, J = 2, H-8), 6.3 (1H, d, J = 2, H-6), 7.4 (5H, s, Ph-4)
^{13}C NMR (22.61 MHz, DMSO-d_6) [36]:

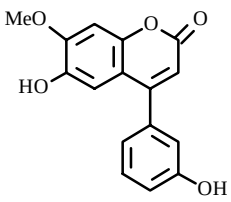
C-2	163.00	C-6	100.40	C-10	158.03	C-4′	128.18
3	96.05	7	158.87	1′	158.00	5′	128.18
4	140.00	8	111.00	2′	128.80	6′	128.80
5	163.88	9	102.40	3′	128.18		

Biol: inhibitor of adenosine-3′,5′-cyclomonophosphate-phosphodiesterase at IC_{50} 7.0×10^{-5} M [34]



116. Seshadrin

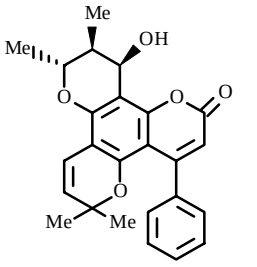
Dalbergia volubilis [16, 135], *Exostema mexicanum* [26]
$C_{17}H_{14}O_6$, **mp** 256-257°C [136]
UV (MeOH) [16]: 232 (4.2), 256 (4.0), 308 (3.8), 344 (4.1)
IR (KBr) [16]: 3340, 3050, 1710, 1615, 1600, 1590, 1450, 1330, 1105, 1080
Mass [16]: 314 (3.9), 313 (15.9), 312 (5.1), 300 (4.9), 299 (27.7), 298 (16.1), 293 (5.3), 284 (16.9), 283 (12.0), 282 (5.2), 281 (8.6), 280 (5.0), 271 (6.7), 270 (5.9), 268 (7.9), 267 (8.0), 258 (3.0), 257 (5.9), 256 (10.1), 258 (3.0)
PMR (60 MHz, $CDCl_3$) [16]: 3.8 (6H, s, OMe), 5.94 (1H, s, H-3), 6.8 (3H, m, H-5, H-6, H-8), 7.3 (1H, d, J = 1.6, H-8), 7.4 (1H, d, J = 1.6, H-6), 9.90 (2H, s, OH)
Biol: antiplasmodial activity against *plasmodium falciparum* [26]



117. Stevenin

Dalbergia stevensonii [54, 137], *D. odorifera* [30, 31], *D. cultrata* [55]
$C_{16}H_{12}O_5$, **mp** 250-254°C [123], 254°C [54]
UV (MeOH) [54]: 222 (4.74), 284 (4.14), 340 (4.05); (MeOH+NaOMe): 252 (4.49), 312 (3.97), 397 (4.08); (MeOH+NaOAc): 301 (4.09), 356 (3.98)
IR ($CDCl_3$) [54]: 3289, 1707, 1667, 1621
Mass [54]: 284 (100) $[M]^+$, 256, 241
PMR (60 MHz, DMSO-d_6) [54]: 3.92 (3H, s, OMe), 6.5 (1H, s, H-3), 6.9-7.53 (6H, m), 9.52 (2H, s)
^{13}C NMR (75.4 MHz, DMSO-d_6) [30]:

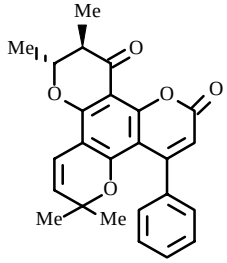
C-2	160.67	C-6	110.61	C-10	111.12	C-4′	116.67
3	111.22	7	152.14	1′	136.81	5′	119.12
4	155.45	8	100.76	2′	115.21	6′	128.80
5	110.61	9	148.62	3′	157.74	7-OMe	56.40



118. Soulattrolide [(-)-*trans*-dihydroinophyllolide]

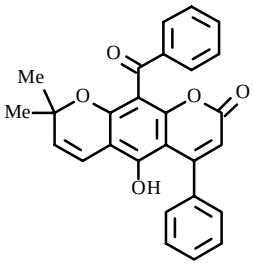
Calophyllum soulattri [138], *C. moonii* [75],
C. teysmannii var. *inophyllolide* [79, 139]
$C_{25}H_{24}O_5$, **mp** 198-200°C [75], 201-202°C [138]
$[\alpha]_D$ -21.8° ($CHCl_3$) [75], -29.6° ($CHCl_3$) [138], -30.2° ($CHCl_3$) [76]
UV (EtOH) [138]: 233 (3.43), 287 (3.37), 335 (3.08)
IR (mineral oil) [138]: 3479, 2930, 2860, 1705, 1640, 1590, 1565, 1470, 1415, 1372, 1349, 1310, 1255, 1230, 1200, 1180,

1150, 1140, 1130, 1115, 1062, 1022, 995, 965, 930, 880, 850, 795, 772, 760, 710, 700
Mass [138]: 404 (20), 389 (62), 386 (46), 371 (100), 333 (46), 317 (3), 305 (3), 202 (3), 193 (4), 178 (16), 164 (5), 115 (5), 105 (5), 78 (6), 42 (6)
PMR ($CDCl_3$) [75]: 0.93 (6H, s, CH_3-10, CH_3-10), 1.18 (3H, d, J = 6.77, CH_3-3), 1.45 (3H, d, J = 6.30, CH_3-2), 1.80 (1H, m, J = 6.77, J = 3.46, J = 10.30, H-3), 2.80 (1H, OH), 4.31 (1H, m, J = 6.29, J = 10.30, H-2), 5.10 (1H, d, J = 3.46, H-4), 5.38 (1H, d, J = 10.0, H-11), 5.96 (1H, s, H-7), 6.55 (1H, d, J = 10.0, H-12), 7.40 (5H, m, Ph-8)
X-ray [76]
Biol: specific inhibitor of HIV-1 RT at IC_{50} 0.34 μM [140]



119. Soulattrolone [(-)-*trans*-inophyllolide]

Calophyllum teysmannii var. *inophyllolide* [79]
$C_{25}H_{22}O_5$, **mp** 187-190°C [138]
$[\alpha]_D$ -45.9° ($CHCl_3$) [138]
UV (EtOH) [138]: 257 (4.46), 266 (4.49), 302 (4.39)
IR (mineral oil) [138]: 2930, 2860, 1740, 1690, 1640, 1600, 1580, 1555, 1405, 1380, 1340, 1315, 1240, 1195, 1190, 1145, 1130, 1089, 1000, 955, 920, 880, 860, 835, 775, 735, 705
Mass [138]: 402 (33) $[M]^+$, 387 (100), 353 (2), 346 (3), 331 (70), 263 (3), 229 (2), 219 (2), 189 (2), 105 (2), 77 (2)
PMR (100 MHz, $CDCl_3$) [138]: 0.98 (6H, s, CH_3-6), 1.24 (3H, d, J = 7.2, CH_3-11), 1.54 (3H, d, J = 6.4, CH_3-10), 2.58 (1H, m, J = 7.2, J = 10.8, H-11), 4.31 (1H, m, J = 6.4, J = 10.8, H-10), 5.41 (1H, d, J = 10, H-7), 6.03 (1H, s, H-3), 6.54 (1H, d, J = 10, H-8), 7.3 (5H, m, Ph-4)

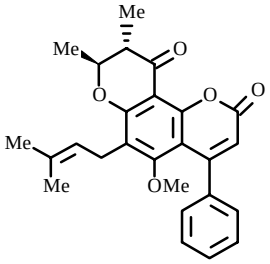


120. Teysmanone A

Calophyllum teysmannii var. *inophyllolide* [80]
$C_{27}H_{20}O_5$, **mp** 238-240°C [80]
UV (EtOH) [80]: 238 (4.15), 280 (4.13), 334 (3.86)
IR (KBr) [80]: 3423, 1700, 1671, 1598, 1447, 1366, 1247, 1193, 1130, 865, 722, 691
Mass [80]: 424 (40) $[M]^+$, 409 (100), 331 (42), 105 (70), 87 (50), 43 (10)
HREIMS [80]: 424.1340 $[M]^+$
PMR (500 MHz, $CDCl_3$) [80]: 1.27 (6H, s, CH_3-12, CH_3-13), 5.55 (1H, d, J = 10.2, H-7), 5.93 (1H, s, H-3), 6.52 (1H, d, J = 10.2, H-6), 7.45 (2H, m, H-3″, H-5″), 7.48 (2H, m, H-2′, H-6′), 7.58 (1H, dd, J = 7.4, J = 1.2, H-4″), 7.61 (3H, m, H-3′, H-4′, H-5′), 7.91 (2H, dd, J = 8.4, J = 1.2, H-2″, H-6″)
HMQC, HMBC [80]
X-ray [71]
^{13}C NMR (125 MHz, $CDCl_3$) [80]:

C-2	158.9	C-7	129.1	C-12	28.0	C-6′	127.5
3	113.1	8	78.3	13	28.0	1″	137.6
4*	152.5	8a	157.7	1′	135.9	2″	129.6
4a	101.1	9**	155.0	2′	127.5	3″	128.5
5**	149.9	10	110.4	3′	130.1	4″	133.5
5a	106.3	10a*	152.7	4′	130.6	5″	128.5
6	115.4	11	191.9	5′	130.1	6″	129.6

*,**Assignments may be reversed

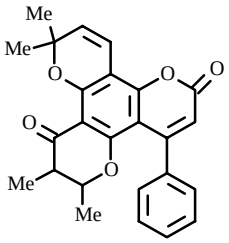


121. Teysmanone B

Calophyllum teysmannii var. *inophyllolide* [80]
$C_{26}H_{26}O_5$
$[\alpha]_D$ +40.5° ($CHCl_3$) [80]
UV (EtOH) [80]: 226 (3.73), 286 (3.40), 342 (3.22)
IR (KBr) [80]: 1718, 1700, 1611, 1577, 1463, 1384, 1114, 696
PMR (500 MHz, $CDCl_3$) [80]: 1.24 (3H, d, J = 7.1, CH_3-12), 1.55 (3H, d, J = 6.5, CH_3-11), 1.67 (3H, s, CH_3-5″), 1.71 (3H, s, CH_3-5″), 2.59 (1H, dq, J = 11.1, J = 7.1, H-9), 3.00 (3H, s, OMe-5), 3.29 (2H, d, J = 6.9, CH_2-1″), 4.33 (1H, dq, J = 11.1, J = 6.5, H-8), 5.08 (1H, m, H-2″), 6.15 (1H, s, H-3), 7.25-7.43 (5H, m, H-2′, H-3′, H-4′, H-5′, H-6′)
Mass [80]: 418 (100) $[M]^+$, 403 (70), 387 (10), 363 (25), 349 (60), 335 (35), 319 (80), 307 (40), 105 (42), 55 (45), 43 (70)
HREIMS [80]: 418.1806 $[M]^+$
^{13}C NMR (125 MHz, $CDCl_3$) [80]:

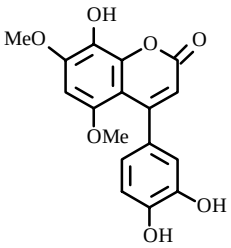
C-2*	159.5	C-8	79.5	C-1′	138.4	C-1″	22.6
3	114.7	9	47.2	2′	127.4	2″	121.7
4**	154.4	10	190.7	3′	127.7	3″	132.2
4a***	107.2	10a***	106.4	4′	128.5	4″	25.6
5*	163.2	10b**	153.7	5′	127.7	5″	17.8
6	120.8	11	19.5	6′	127.4	OMe-5	62.0
6a*	160.4	12	10.4				

*,**,***Assignments may be reversed



122. Tomentolide A

Calophyllum tomentosum [7]
$C_{25}H_{22}O_5$, **mp** 201-205°C [7]
UV [7]: 237 (4.63), 275-280 (4.59), 350 (3.9)
IR [7]: 1740, 1690, 753, 699
Mass [7]: 402, 387, 331, 303
PMR ($CDCl_3$) [7]: 0.71 (3H, d, J = 6), 1.0 (3H, d, J = 6), 1.49 (3H, s), 1.52 (3H, s), 2.18 (1H, m), 3.78 (1H, m), 5.58 (1H, d, J = 10), 5.85 (1H, s), 6.78 (1H, d, J = 10)



123. 8,3′,4′-Trihydroxy-5,7-dimethoxy-4-phenylcoumarin

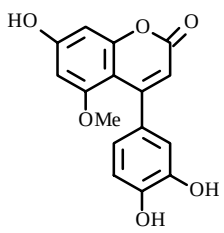
Couterea hexandra [33, 141], *Exostema mexicanum* [26]
$C_{17}H_{14}O_7$, **mp** 253-255°C [33]
UV (MeOH) [141]: 265 (2.81), 280 (2.98), 327 (3.6), 427 (2.48);
(MeOH+NaOMe): 287, 330, 386
Mass [141]: 330 (100) $[M]^+$, 302 (13), 287 (21), 259 (7)
HREIMS [141]: 330.0824
PMR (200 MHz, CD_3OD) [141]: 3.50 (3H, s, OMe-5), 3.98 (3H, s, OMe-7), 5.90 (1H, s, H-3), 6.57 (1H, s, H-6), 6.66 (1H, dd, J = 2, J = 7.5, H-6′), 6.75 (1H, d, J = 2, H-2′), 6.81 (1H, d, J = 7.5, H-5′)

^{13}C NMR (69.5 MHz, CD_3OD) [141]:

C-2	162.8	C-6	95.9	C-1′	133.1	C-5′	115.6
3	112.6	7*	152.5	2′	116.2	6′	120.4
4	158.7	8	129.6	3′	145.5	OMe	57.1
4a	105.4	8a	145.2	4′	146.8	OMe	57.2
5*	152.9						

*Assignments may be reversed

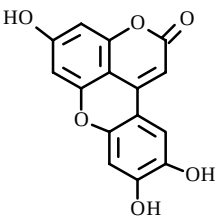
Biol: inhibitor of adenosine-3′,5′-cyclomonophosphate-phosphodiesterase at IC_{50} 3.7×10^{-5} M [34], antiplasmodial activity against *Plasmodium falciparum* [26]



124. 7,3′,4′-Trihydroxy-5-methoxyneoflavone

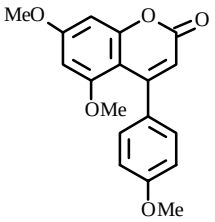
Coutarea hexandra [142]
$C_{16}H_{12}O_6$, **mp** 269-270°C [142]
UV (MeOH) [142]: 259 (4.43), 332 (4.77); (MeOH+NaOAc): 257, 272, 332, 378; (MeOH+NaOMe): 245, 271, 381
Mass [142]: 300 (100) $[M]^+$, 272 (100), 257 (12), 239 (30), 229 (8), 211 (12), 150 (6), 136 (4)
PMR [$(CD_3)_2CO$] [142]: 3.53 (3H, s, 5-OMe), 5.80 (1H, s, H-3), 6.36 (1H, d, J = 2.5, H-6), 6.43 (1H, d, J = 2.5, H-8), 6.68 (1H, dd, J = 2, J = 8, H-6′), 6.83 (1H, d, J = 2, H-2′), 6.85 (1H, d, J = 8, H-5′)
^{13}C NMR [$(CD_3)_2CO$] [142]:

C-2	160.7	C-5	159.9	C-8a	158.2	C-4′	146.1
3	112.1	6	97.0	1′	132.7	5′	115.1
4	156.7	7	162.6	2′	115.8	6′	120.1
4a	103.4	8	96.7	3′	145.0	OMe	56.0



125. 7,4′,5′-Trihydroxy-4-phenyl-5,2′-oxidocoumarin

Exostema caribaeum [19]
$C_{15}H_8O_6$, **mp** 350°C (dec.) [19]
UV (MeOH) [19]: 262, 310, 350, 372, 390; (MeOH+$AlCl_3$): 325, 404; (MeOH+$AlCl_3$+HCl): 262, 310, 350, 372, 390
IR (KBr) [19]: 3425, 3250, 1690, 1630, 1560, 1460, 1298, 1170, 830
Mass [19]: 284 (100), 256 (35), 241 (10), 228 (50)
PMR (80 MHz, $CDCl_3$/DMSO-d_6) [19]: 5.91 (1H, s, H-3), 6.44 (2H, s, H-6, H-8), 6.73 (1H, s, H-3′), 7.21 (1H, s, H-6′), 10.30 (3H, s, OH)

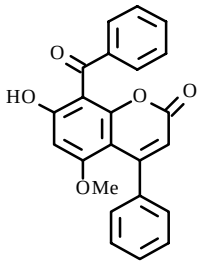


126. 5,7,4′-Trimethoxy-4-phenylcoumarin

Coutarea hexandra [24], *Chiococca alba* [143], *Exostema caribaeum* [11], *E. acuminatum* [22], *Indigofera oblongifolia* [144]
$C_{18}H_{16}O_5$, **mp** 150-152°C [22], 151-152°C [24], 152°C [143]
UV ($CHCl_3$) [143]: 260 (4.06), 315 (4.25)
IR (KBr) [143]: 1710, 1625, 1590, 1510, 1160, 1110, 1060, 950, 872, 860, 840
Mass [143]: 312 (100) $[M]^+$, 284 (51), 269 (48), 241 (2)
PMR (200 MHz, $CDCl_3$) [143]: 3.48 (3H, s, OMe-5), 3.87 (6H, s, OMe-7, OMe-4′), 5.90 (1H, s, H-3), 6.24 (1H, d, J = 2.5, H-6), 6.53 (1H, d, J = 2.5, H-8), 6.93 (2H, d, J = 8.5, H-3′, H-5′), 7.25 (2H, d, J = 8.5, H-2′, H-6′)
^{13}C NMR (125.7 MHz, $CDCl_3$) [22]:

C-2	161.2	C-6	96.0	C-2′	129.1	C-6′	129.1
3	112.8	7	163.6	3′	113.1	OMe-7	56.1
4	157.6	8	94.0	4′	160.0	OMe-7	55.8
4a	103.9	8a	158.6	5′	113.1	OMe-4′	55.7
5	158.6	1′	132.4				

Biol: cytotoxic activity against cell lines BC1, Lu1, Col2, KB, KB-V^+, KB-V^-, LNCaP, SW626, SKNSH, and M109 [22]

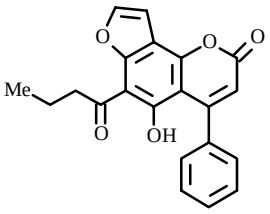


127. 4-Phenyl-5-methoxy-7-hydroxy-8-benzoylcoumarin

Calophyllum teysmannii var. *inophylloide* [20]
$C_{23}H_{16}O_5$, **mp** 220-222°C [20]
UV [20]: 252, 290, 328
IR [20]: 3427, 3082, 2927, 1723, 1627, 1595, 1575, 1360, 1263, 1106, 861, 777, 739, 701
Mass [20]: 372 (62) $[M]^+$, 371 (100), 343 (40), 149 (6), 105 (54), 77 (57)
HR-EIMS [20]: 372.1002
PMR (500 MHz, $CDCl_3$) [20]: 3.50 (3H, s, MeO-5), 5.93 (1H, s, H-3), 6.33 (1H, s, H-6), 7.24 (2H, m, H-2′, H-6′), 7.38 (3H, m, H-3′, H-4′, H-5′), 7.48 (2H, t, J = 8.0, H-3″, H-5″), 7.60 (1H, tt, J = 8.0, J = 1.6, H-4″), 7.65 (2H, dd, J = 8.0, J = 1.6, H-2″, H-6″), 12.30 (s, 1H, OH-7)
HMBC, NOE [20]
^{13}C NMR (125 MHz, $CDCl_3$) [20]:

C-2*	158.1	C-7***	167.0	C-3′	127.4	C-3″	128.1
3	112.8	8**	104.3	4′	127.9	4″	132.3
4*	155.5	8a*	156.8	5′	127.4	5″	128.1
4a**	102.6	9	198.5	6′	126.8	6″	128.1
5***	162.4	1′	139.5	1″	140.1	OMe	55.6
6	96.1	2′	126.8	2″	128.1		

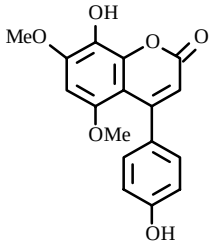
*,**,***Assignments may be reversed



128. Furanoracemosone

Mesua racemosa [72]
$C_{21}H_{16}O_5$
UV (EtOH+HCl) [72]: 289 (3.66), 238 (3.54); (EtOH+NaOH): 279 (3.64), 377 (3.17)
IR [72]: 3447, 2958, 1742, 1612, 1161, 1136, 762, 698
Mass [72]: 349 (13), 348 (53), 333 (6), 306 (12), 305 (100), 277 (10), 221 (7), 71 (6), 69 (10), 57 (10), 55 (6), 43 (9), 28 (12), 18 (8)
HREIMS [72]: 348.0973 $[M]^+$
PMR (270 MHz, $CDCl_3$) [72]: 1.05 (3H, t, J = 7.0, CH_3-4″), 1.79 (2H, m, CH_2-3″), 3.25 (2H, t, J = 7.0, CH_2-2″), 6.17 (1H, s, H-3), 7.16 (1H, d, J = 2.0, H-9), 7.36 (2H, m, H-2′, H-6′), 7.43 (3H, m, H-3′, H-4′, H-5′), 7.68 (1H, d, J = 2.0, H-8), 14.53 (1H, s, OH-5)
HMBC [72]
^{13}**C NMR** (67.5 MHz, $CDCl_3$) [72]:

C-2	159.3	C-6a	156.0	C-1′	138.9	C-6′	127.2
3	114.3	8	143.9	2′	127.2	1″	204.5
4	156.8	9	104.7	3′	127.7	2″	44.9
4a	104.7	9a	109.7	4′	128.4	3″	17.5
5	162.7	9b	153.3	5′	127.7	4″	13.8
6	103.7						

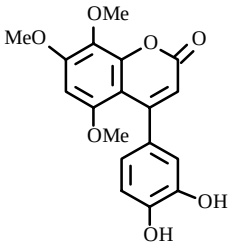


129. Exomexin A

Exostema mexiacnum [26]
$C_{17}H_{14}O_6$
Mass [26]: 314 $[M]^+$, 299, 286, 271, 267, 243, 228
HRMS [26]: 314.07916
PMR (400 MHz, CD_3COCD_3) [26]: 3.50 (3H, s, OMe), 3.97 (3H, s, OMe), 5.84 (1H, s, H-3), 6.64 (1H, s, H-6), 6.87 (2H, d, J = 8.6, H-3′, H-5′), 7.20 (2H, d, J = 8.6, H-2′, H-6′), 7.74 (1H, s, OH), 8.51 (1H, s, OH)
^{13}C NMR (100 MHz, CD_3OD) [26]:

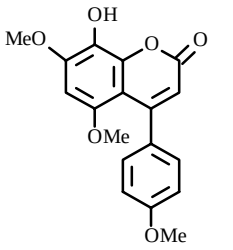
C-2	163.0	C-6	95.0	C-1′	132.4	C-5′	115.3
3	112.5	7	152.9	2′	130.0	6′	130.0
4	145.1	8	127.4	3′	115.3	OMe-7	57.0
4a	104.9	8a	158.8	4′	159.0	OMe-5	56.7
5	152.4						

Biol: antiplasmodial activity against *Plasmodium falciparum* [26]



130. Exomexin B

Exostema mexicanum [26]
$C_{18}H_{16}O_6$
Mass [26]: 344 $[M]^+$, 329, 316, 301, 273
HRMS [26]: 344.08948
PMR (400 MHz, CD_3COCD_3) [26]: 3.57 (3H, s, OMe), 3.83 (3H, s, OMe), 3.99 (3H, s, OMe), 5.86 (1H, s, H-3), 6.63 (1H, s, H-6), 6.68 (1H, dd, J = 8.1, J = 2.1, H-6′), 6.83 (1H, d, J = 2.1, H-2′), 6.85 (1H, d, J = 8.1, H-5′), 8.09 (1H, s, OH), 8.11 (1H, s, OH)
Biol: antiplasmodial activity against *Plasmodium falciparum* [26]



131. Exostemin

Exostema caribaeum [145, 146], *E. acuminatum* [22], *Coutarea hexandra* [25], *Chiococca alba* [25]
$C_{18}H_{16}O_6$, **mp** 158-160°C [22], 173-174°C [145, 146], 195-196°C [147]
UV (MeOH) [143]: 260 (4.06), 315 (4.26)
IR (KBr) [143]: 3450, 1710, 1590, 1515, 1170, 1110, 1070, 950, 875, 865, 845
Mass [143]: 328 (100), 312 (40), 299 (24), 284 (38), 269 (6), 257 (10), 201 (7)
PMR (200 MHz, $CDCl_3$) [143]: 3.46 (3H, s, OMe-5), 3.87 (3H, s, OMe-4′), 3.98 (3H, s, OMe-7), 5.75 (1H, s, OH-8), 5.80 (1H, s, H-3), 6.34 (1H, s, H-6), 6.92 (2H, d, J = 8.5, H-3′, H-5′), 7.24 (2H, d, J = 8.5, H-2′, H-6′)
^{13}C NMR (125.7 MHz, DMSO-d_6) [22]:

C-2	160.1	C-6	93.6	C-2′	129.2	C-6′	129.2
3	113.0	7	151.3	3′	113.2	OMe	56.9
4	156.2	8	151.3	4′	160.4	OMe	56.7
4a	104.9	8a	143.4	5′	113.2	OMe	55.7
5	150.3	1′	127.9				

Biol: inhibitor of adenosine-3′,5′-cyclomonophosphate-phosphodiesterase at IC_{50} 10.4×10^{-5} M [34], cytotoxic activity against cell lines BC1, Lu1, Col2, KB, KB-V^+, KB-V^-, LNCaP, SW626, SKNSH, and M109 [22]

It should especially be noted that inophyllum A (**51**), B (**52**), C (**53**), D (**54**), E (**55**), and calophyllolide (**73**), which were previously isolated from *Calophyllum inophyllum* [74], were isolated from the acetone extract of the giant African snail *Achatina fulica*, whose principal food source are leaves of *Calophyllum* and which was collected in the Seychelles islands. This is the single described instance of neoflavones isolated from a non-plant source.

Table 1 lists plants that produce neoflavones and 4-phenylcoumarins.

Definite structural trends are observed among natural 4-phenylcoumarins. Neoflavones isolated from plants of the Clusiaceae and Thelypteridaceae families have the phloroglucinol orientation of the hydroxyls in benzene ring A and unsubstituted benzene ring B. Neoflavones produced by plants of the Rubiaceae family contain a mono- or dioxygenated 4-phenyl substituent. Both unsubstituted and substituted benzene rings B are characteristic of neoflavones found in plants of the Fabaceae family. All coumarins obtained from plants of the Thelypteridaceae family contain a methyl substituent in the 6-position of the coumarin system.

TABLE 1. Plant Sources of Neoflavones

Plant	Isolated neoflavones
Clusiaceae family	
Calophyllum apetalum	Apetatolide (**1**) [6, 7]
C. australianum	Calaustralin (**68**) [84]
C. bracteatum	Calophyllolide (**73**) [90]
C. dispar	Disparacetylfuran A (**38**) [66], dispardiol B (**39**) [67], disparinol A (**40**) [68], disparinol B (**41**) [68], disparinol D (**42**) [67], disparfuran B (**43**) [66], isodispar B (**45**) [67], isodisparinol A (**46**) [68], isodisparinol B (**47**) [68], isodisparfuran A (**48**) [66], mammea A/AA dehydrocyclo F (**78**) [66], mammea A/AA methoxycyclo F (**79**) [66], mammea A/AA cyclo F (**81**) [66], mammea A/AB dioxalanocyclo F (**83**) [67], mammea A/AB cyclo E (**85**) [67], mammea A/AB cyclo F (**86**) [66], mammea A/AC cyclo F (**88**) [66], mammea A/BA cyclo F (**95**) [66], mammea A/BB cyclo F (**98**) [66], mammea A/BC cyclo F (**100**) [66]
C. inophyllum	Acetatolide (**1**) [8], inophyllum A (**51**) [73, 74], inophyllum B (**52**) [73, 74, 77], inophyllum C (**53**) [73, 74, 77, 78], inophyllum D (**54**) [73, 74], inophyllum E (**55**) [73, 74, 77], inophyllum G-1 (**56**) [74], inophyllum G-2 (**57**) [74], inophyllum P (**58**) [58], (-)-calaustralin (**69**) [85], calocoumarin A (**70**) [86], calocoumarin B (**71**) [86], calocoumarin C (**72**) [86], calophyllolide (**73**) [1, 77, 87, 88, 89], mammea A/BB cyclo D (**97**) [87]
C. moonii	Inophyllum A (**51**) [75], soulatrolide (**118**) [75]
C. aff. *Pervillei*	Calophyllolide (**73**) [91]
C. soulattri	Soulatrolide (**118**) [138]
C. teysmannii var *inophylloide*	9-Benzoyl-6-hydroxy-5-methoxy-4-phenylnodakenetin (**5**) [14], (-)-6-benzoyl-5-hydroxy-4-phenylcolumbianelin (**6**) [14], 9-benzoyl-5-methoxy-4-phenylnodakenetin (**7**) [14], hydrohydroxyisocalanone (**14**) [20], *trans*-7,8-dihydroxycalanone (**32**) [14], isocalanone (**49**) [14, 70], inophyllum C (**53**) [14, 79, 80], inophyllum E (**55**) [80], calanone (**67**) [14, 20, 79, 80], O-methylisocalaustralin (**105**) [14], O-methylcalaustralin (**106**) [14], 12-methoxyinophyllum P (**109**) [20], soulatrolide (**118**) [79, 139], soulatrolone (**119**) [79], teysmanone A (**120**) [80], teysmanone B (**121**) [80], 4-phenyl-5-methoxy-7-hydroxy-8-benzoylcoumarin (**127**) [20]
C. tomentosum	Tomentolide A (**122**) [7]
Kayea assamica	Mammea A/AA (**77**) [103], mammea A/AA cyclo F (**81**) [103]
Kielmeyera argentea	Coumarins **23** [35] and **24** [35]
K. elata	Hydroxymammeigin (**18**) [29], mammea A/AA (**77**) [29], mammea A/AA cyclo D (**80**) [29], mammea A/AA cyclo F (**81**) [29]
K. lathrophyton	Mammea A/AA cyclo D (**80**) [111], mammea A/AB cyclo D (**84**) [111]
K. pumila	Mammea A/AA cyclo D (**80**) [110], mammea A/AB cyclo F (**86**) [110], mammea A/BA cyclo D (**94**) [110]
K. reticulata	Coumarins **15** [21], **23** [21], **24** [21], and **29** [21]
Mammea africana	Mammea A/AA (**77**) [98, 99], mammea A/AB (**82**) [98, 99], mammea A/AB cyclo D (**84**) [98, 99], mammea A/AB cyclo F (**86**) [98, 99], mammea A/AD (**90**) [6, 104], mammea A/BA (**93**) [116]
M. americana	Mammea A/AA (**77**) [96, 97], mammea A/AA cyclo D (**80**) [107, 108], mammea A/AA cyclo F (**81**) [113], mammea A/AB (**82**) [115, 116], mammea A/AB cyclo F (**86**) [113, 114], mammea A/AC cyclo F (**88**) [114], mammea A/AD (**90**) [119], mammea A/AD cyclo D (**91**) [6], mammea A/AD cyclo F (**92**) [114], mammea A/BA (**93**) [115, 116], mammea A/BB (**96**) [115, 116], mammea A/BB cyclo D (**97**) [105]
M. siamensis	Mammea A/AC cyclo D (**89**) [118]
Mesua ferrea	Coumarins **20** and **35** [32], mammea A/AA (**77**) [100], mammea A/AA cyclo D (**80**) [104, 109], mammea A/AD (**90**) [104], mammea A/AD cyclo D (**91**) [109], mesuarin (**101**) [120]
M. racemosa	Isoracemosol (**50**) [72], mammea A/AA (**77**) [101], mammea A/AC (**87**) [101], mammea A/AC cyclo F (**88**) [101], mammea A/AC cyclo D (**89**) [101], mammea A/AD cyclo D (**91**) [101], mammea A/BB (**96**) [101], mammea A/BC (**99**) [72], racemosol (**113**) [101], racemosone (**114**) [72], furanoracemosol (**128**) [72]
M. thwaitesii	Mammea A/AA (**77**) [102], mammea A/AA cyclo D (**80**) [102], mammea A/AA cyclo F (**81**) [102], mammea A/AD (**90**) [102], mammea A/AD cyclo D (**91**) [102]
Ochrocarpus siamensis	Mammea A/AC (**87**) [117], mammea A/AC cyclo D (**89**) [117]

TABLE 1. (continued)

Plant	Isolated neoflavones
Rubiaceae family	
Chiococca alba	Coumarin **126** [143], exostemin (**131**) [143]
Coutarea hexandra	Coutareagenin (**74**) [92, 93], coumarins **2** [10], **17** [24, 25], **21** [33], **22** [24], **26** [10], **27** [10], **31** [24, 64], **33** [33], **37** [65], **75** [10], **123** [33, 141], **124** [142], and **126** [24], 8-O-methylexostemin (**107**) [25], exostemin (**131**) [25]
Exostema acuminatum	Coumarins **16** [22], **22** [22], **30** [22], **33** [22], and **126** [22], exostemin (**131**) [22]
E. caribaeum	Coumarins **3** [11], **11** [19], **13** [11], **26** [11], **30** [11], and **126** [11], oxidocoumarins **36** [19], **108** [11], and **125** [19], exostemin (**131**) [145, 146]
E. mexicanum	Coumarins **17** [26], **22** [26], **26** [37], **31** [26], and **123** [26], 8-O-methylexostemin (**107**) [26], seshadrin (**116**) [26], exomexin A (**129**) [26], exomexin B (**130**) [26]
Hintonia latiflora	Coumarins **3** [12], **4** [13], **11** [12], **12** [12], **26** [12], and **27** [12], oxidocoumarin **108** [128]
Leguminosae (Fabaceae) family	
Cassia alata	Dalbergin (**28**) [62]
Dalbergia baroni	Dalbergin (**28**) [52, 53], melanein (**102**) [52, 53]
D. cearensis	Dalbergin (**28**) [47]
D. coromandeliana	Dalbergin (**28**) [51]
D. cultrata	Dalbergin (**28**) [55], stevenin (**117**) [55]
D. latifolia	Dalbergin (**28**) [42], O-methyldalbergin (**104**) [42]
D. melanoxylon	Dalbergin (**28**) [43], melanein (**102**) [52, 53], melanetin (**103**) [122]
D. miscolobium	Dalbergin (**28**) [45]
D. nigra	Dalbergin (**28**) [44], O-methyldalbergin (**104**) [44]
D. nitidula	Dalbergin (**28**) [48]
D. odorifera	3′-Hydroxymelanetin (**19**) [30, 31], dalbergin (**28**) [30, 31], melanetin (**103**) [30, 31], stevenin (**117**) [30, 31]
D. riparia	Dalbergin (**28**) [49]
D. sissoides	Dalbergin (**28**) [46]
D. sissoo	Dalbergin (**28**) [40, 41], isodalbergin (**44**) [69], O-methyldalbergin (**104**) [125], nordalbergin (**112**) [125]
D. spinosa	Dalbergin (**28**) [50]
D. stevensonii	Dalbergin (**28**) [54], stevenin (**117**) [54, 137]
D. volubilis	Volubolin (**8**) [15, 16], voludal (**9**) [16, 17], dalbergin (**28**) [15, 16], seshadrin (**116**) [16, 135]
Glycyrrhiza inflata	Inflacoumarin A (**66**) [82, 83]
Goniorrhachis marginata	Dalbergin (**28**) [61], O-methyldalbergin (**104**) [61]
Indigofera oblongifolia	Coumarin **126** [144]
Machaerium kuhlmannii	Dalbergin (**28**) [56], kuhlmannin (**76**) [56, 95]
M. nictitans	Dalbergin (**28**) [56], kuhlmannin (**76**) [56, 95]
M. pedicellatum	Dalbergin (**28**) [58], kuhlmannin (**76**) [58], O-methyldalbergin (**104**) [58]
M. scleroxylon	Dalbergin (**28**) [57], O-methyldalbergin (**104**) [57]
Piptadenia macrocarpa	Dalbergin (**28**) [59], kuhlmannin (**76**) [59]
Prosopis kuntzei	Dalbergin (**28**) [60], O-methyldalbergin (**104**) [60]
Thelypteridaceae family	
Cyclosorus interruptus	Interruptins A (**59**) [81], B (**60**) [81], C (**61**) [81], D (**62**) [81], E (**63**) [81], F (**64**) [81], and G (**65**) [81]
Passifloraceae family	
Passiflora serratodigitata	Serratin (**115**) [36], serratin 7-β-glucoside (**25**) [36]
Asteraceae family	
Echinops niveus	Nivegin (**110**) [129, 130], nivetin (**111**) [130]
Rutaceae family	
Hesperethusa crenulata	Coumarin **10** [18]

There are several classifications for neoflavones isolated from plants of the Clusiaceae family [105, 148]. Considering the various structural features of the side chains and the structures of the fused rings in addition to their positions in the molecules, neoflavones can be divided into the following groups:

1. Hydroxy- and methoxycoumarins:

a) with hydroxyls or methoxyls (compounds **8**, **16**, **17**, **19**, **21**, **22**, **28**, **30**, **31**, **33**, **37**, **44**, **74**, **76**, **102-104**, **107**, **110-112**, **115-117**, **123**, **124**, **126**, **129-131**);

b) alkylated hydroxycoumarin (**66**);

c) 6-formylcoumarin (**9**);

d) acylated hydroxyneoflavones (**45**, **59-61**, **114**, **127**).

2. O-Glycosides with the carbohydrate in the coumarin 5- (**2-4**, **11-13**, **26**, **27**, **75**), 6- (**10**), and 7-positions (**25**).

3. Neoflavones containing both alkyl and acyl substituents in benzene ring A:

a) 6-acyl-8-alkylcoumarins (**29**, **34**, **39**, **40-42**, **77**, **82**, **87**, **90**, **113**);

b) 8-acyl-6-alkylcoumarins (**35**, **46**, **47**, **50**, **93**, **96**, **99**).

4. Furocoumarins (**38**, **43**, **48**, **128**).

5. Dihydrofurocoumarins containing a dihydrofuran fused at the C-5—C-6 (**14**, **95**, **98**, **100**), C-6—C-7 (**5**, **7**), and C-7—C-8 positions (**6**, **62**, **63**, **64**, **78**, **79**, **81**, **83**, **86**, **88**, **92**) of a 4-phenylcoumarin and substituents in the dihydrofuran and benzene rings.

6. Pyranocoumarins (chromeno-α-pyrones) containing 2,2-dimethylchromene condensed with 4-phenylcoumarin at the C-5—C-6 (**15**, **20**, **24**, **67**, **73**, **94**, **97**), C-6—C-7 (**1**, **120**), and C-7—C-8 positions (**18**, **23**, **49**, **80**, **84**, **89**, **91**, **101**, **22-29**) and acyl substituents in the neoflavone benzene ring A and pyran (**32**, **85**).

7. Chromanone-coumarins containing a fused 2,3-dimethylchromanone at the C-6—C-7 (**68**, **69**, **105**, **106**) and C-7—C-8 positions (**70**, **121**) of the neoflavone skeleton.

8. Tetracyclic 4-phenylcoumarins:

a) containing a 2,3-dimethylchromanone ring in the C-7—C-8 position and 2,2-dimethylchromene moiety at the C-5—C-6 position (**53**, **55**, **119**);

b) containing a 2,3-dimethylchromanone ring at the C-5—C-6 position and a 2,2-dimethylchromene moiety at the C-7—C-8 position (**122**);

c) containing a 2,3-dimethylchromanol ring at the C-7—C-8 position and a 2,2-dimethylchromene moiety at the C-5—C-6 position (**51**, **52**, **54**, **58**, **109**, **118**);

d) containing a 2,3-dimethylchromanol ring at the C-7—C-8 position and dimethylcyclopropanedihydrofuran and analogous fragments at the C-5—C-6 position (**56**, **57**, **71**, **72**).

9. 4-Phenyl-5,2′-oxidocoumarins (**36**, **108**, **125**).

10. 7,10-Dioxocancoumarin (**65**).

Neoflavones often contain one or several free hydroxyls that are most frequently found in benzene ring A and much more rarely in ring B. O-Alkyl derivatives are represented exclusively as methoxyls. The C-alkyl substituents include primarily the prenyl group (**29**, **34**, **66**, **68-70**, **77**, **82**, **87**, **90**, **93**, **96**, **99**, **105**, **106**, **121**), more rarely 2-hydroxy-3-methylbut-3-enyl (**40-42**, **46**, **47**, **50**, **113**), and in unique instances 2,3-dihydroxy-3-methylbutyl (**39**) and geranyl (**35**) substituents. The glycoside fragment is most often β-D-galactopyranose (**10-13**) and β-D-glucopyranose (**25-27**). In single instances 6-acetyl-β-D-glucopyranose (**4**) and 6-acetyl-β-D-galactopyranose (**3**) in addition to disaccharides D-apiofuranosyl-(1→6)-β-D-glucopyranose (**2**) and β-D-xylopyranosyl-(1→6)-β-D-glucopyranose (**75**) are observed. Among the C-acyl substituents are 3-methylbutane (**38**, **40**, **45**, **46**, **48**, **77-81**, **93-95**), 2-methylbutane (**20**, **35**, **39**, **41**, **43**, **47**, **82-86**, **96-98**), butane (**50**, **87**, **88**, **89**, **99**, **100**, **113**, **114**, **128**), 2-methylpropionic (**42**, **90-92**, **101**), acetic (**38**, **114**), benzoic (**5-7**, **14**, **32**, **49**, **67**, **120**, **127**), and 2-methylbut-2-enoic (**1**, **71**, **73**) acids in addition to 4-hydroxy-3-methyl-1-oxobutanoic acid (**15**, **18**, **29**) and its 4-cinnamoyl derivatives (**23**, **24**, **34**). 3-Phenylpropionic (**59**), 3-phenyl-*trans*-acrylic (**60**), and 2-hydroxy-3-phenylpropionic (**61**) acids are found anecdotally. The neoflavone voludal (**9**) has an aldehyde in the 6-position of the coumarin.

PHYSICAL RESEARCH METHODS

The application of modern physical methods to research on the structure determination of neoflavones reduced significantly the amount of study by chemical methods that was necessary previously, accelerated the elucidation of structures, and also made it possible to work with microquantities of compounds.

INFRARED SPECTROSCOPY

The IR spectra of neoflavones, like for all compounds based on the coumarin skeleton, have a band very characteristic of C=O stretching at 1750-1690 cm^{-1}. The IR spectra also exhibit absorption bands in the ranges 1520-1570 and 1600-1630 cm^{-1} due to vibrations of the α-pyrone ring in addition to bands at 690-700 and 740-750 cm^{-1} due to vibrations of the monosubstituted phenyl ring.

ULTRAVIOLET SPECTROSCOPY

UV spectroscopy is used to establish the structure of 4-phenylcoumarins mainly for determining the orientation of the acyl substituents. All 6-acyl coumarin derivatives have a characteristic absorption maximum at 614 nm in the Gibbs test whereas the 8-acylisomers do not absorb in this region [116]. The UV spectra of 6-acylcoumarins typically have an absorption maximum at 280 nm whereas 8-acylcoumarins exhibit an absorption maximum at 290 nm [105, 115, 116]. It should be noted that the long-wavelength absorption band of 6-acylcoumarins undergoes a large bathochromic shift upon the addition of base (290 to 330 nm) whereas a small bathochromic shift of the long-wavelength band is observed (280 to 300 nm) for 8-acylcoumarins [105, 115, 116].

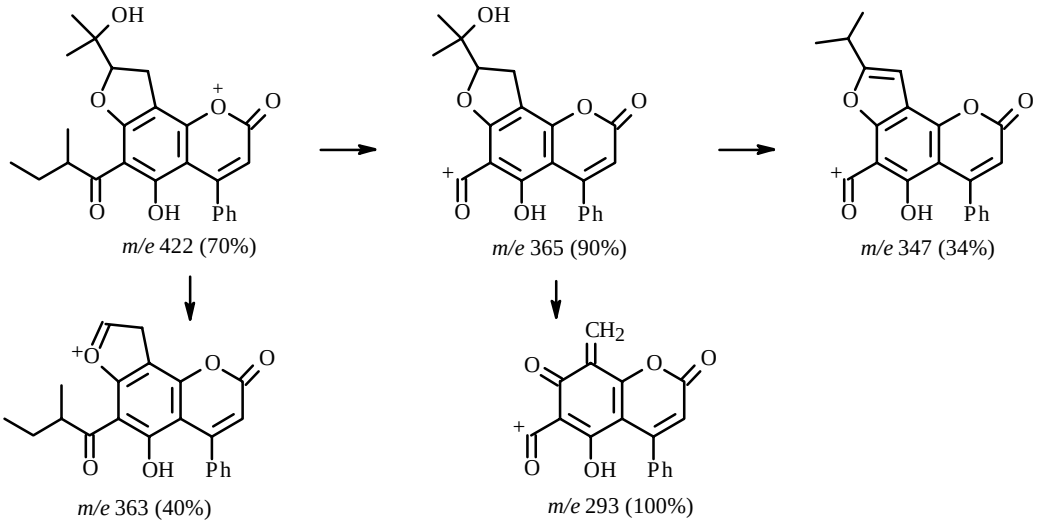
MASS SPECTROSCOPY

Most reports contain data for the mass numbers and relative intensities of the molecular ions or the base and principal ions.

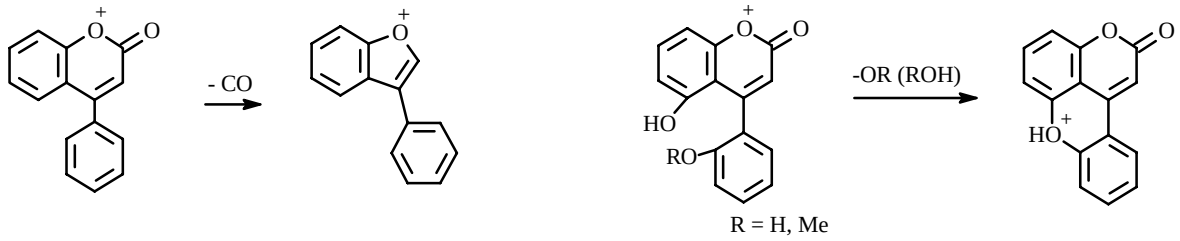
Mass spectra of neoflavones isolated from *Mammea americana*, *M. africana*, and *Calophyllym inophyllum* have been studied in the most detail [8, 98, 99, 116]. Simultaneous application of gas chromatography and mass spectroscopy to identify natural 4-phenylcoumarins and the overall fragmentation pathways of the molecular ions has been described [8]. Mass spectra of mammea A/AA cyclo D (**80**) and mammea A/AB cyclo D (**84**) have base peaks formed by loss of a methyl from the molecular ion, which indicates that the molecule contains a 2,2-dimethylchromene. Fragmentation of the molecular ion by loss of 2-methylbutyryl or 3-methylbutyryl forms the [M - 57] ion.

Mammea A/AA (**77**) and mammea A/AB (**82**) have similar mass spectra [116]. The spectra of these compounds contain [M - 57] peaks due to cleavage of the butyl group of the acyl substituent and [M - 57 - 56] indicative of further elimination of butene from the 3-methylbut-3-enyl substituent. The situation is analogous for the mass spectrum of mammea A/AD (**90**). Loss of a propyl radical from the acyl substituent gives the [M - 43] peak. Further cleavage of butene from the 3-methylbut-2-ene substituent gives the [M - 43 - 56] peak. Mass spectra of these 4-phenylcoumarins contain common characteristic ions at *m*/*e* 169 and 171 [116].

Common decomposition pathways are observed in the mass spectra of mammea A/AB [**82**), mammea A/AB cyclo D (**84**), and mammea A/AB cyclo F (**86**) [98]. The spectra of these compounds contain [M - 57] peaks due to elimination of a butyl radical of the acyl moiety on C-6. The spectrum of compound **82** contains additional peaks for [M - 57 - 55] and [M - 55] due to cleavage of butene or butenyl radicals during fragmentation of the 3,3-dimethylallyl substituent. The mass spectrum of compound **84** has the base peak [M - 15] that is typical of the exceedingly stable benzopyryl ion. The fragmentation pattern of mammea A/AB cyclo F (**86**) has been reported [99]. The [M - 75] ion is formed by loss of water from the [M - 57] ion; the [M - 129] ion, by elimination of isobutenoxide from the [M - 57] ion (Scheme 1).



Scheme 1



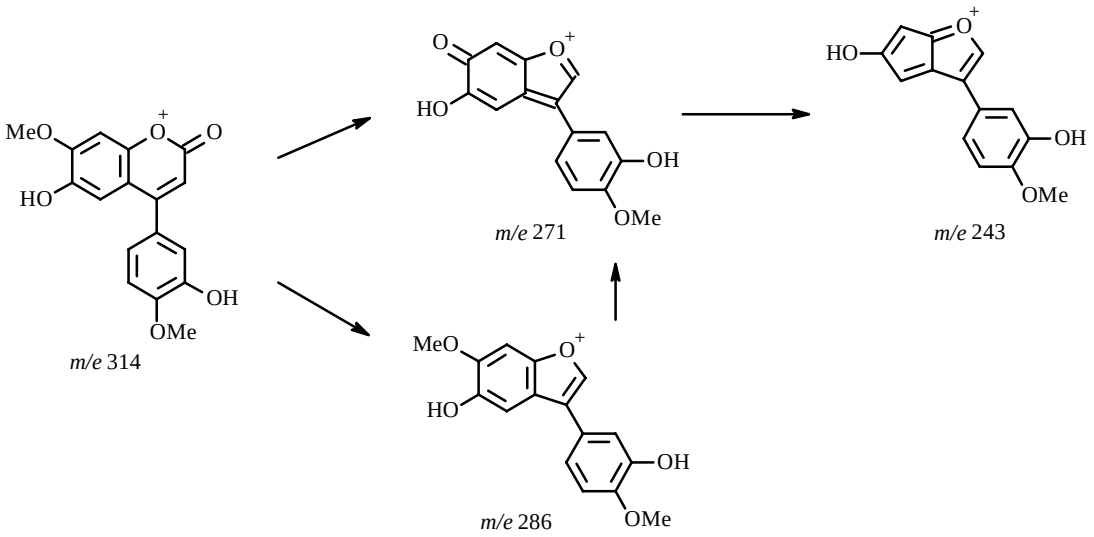
Scheme 2

The base peak $[M]^+$ (C_4H_7O) in the mass spectra of disparinols A (**40**) and B (**41**) and racemosol (**113**) corresponds to fragmentation of the 2-hydroxy-3-methylbutyl-3-ene substituent [68, 101]. The presence in mammea A/AC cyclo F (**88**) of an oxobutyryl substituent and a hydroxyisopropyldihydrofuran ring is confirmed by the presence in the mass spectrum of two base peaks for $[M - 43]^+$ $[M - CH_2CH_2CH_3]^+$ and $[M - 115]^+$ $[M - 43 - 72]^+$, which are formed by elimination of isobuteneoxide from the $[M - 43]^+$ fragment [101].

The mass spectrum of tomentolide A (**122**) [7] has a peak for the molecular ion at *m/e* 402. A strong peak at *m/e* 387 [M - 15] corresponds to the stable benzopyryl ion 2,2-dimethylchromene. Other important peaks with *m/e* 331 [M - 15 - 56] and *m/e* 303 [M - 15 - 56 - 28] are formed by successive loss of butene and CO from the ion with *m/e* 387 [7]. The spectrum of apetatolide (**1**) is characterized by a strong peak with *m/e* 401 [M - 15] and a peak with *m/e* 361 [M - 55] that correspond to loss of C_4H_7 from the acyl substituent [7]. A strong base peak for [M - 15] in the mass spectrum of isomammeigin (**94**) indicates the presence in it of a 2,2-dimethylpyran ring [110].

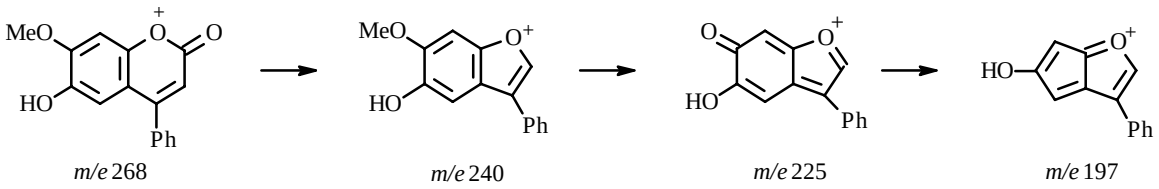
Two important conclusions were made about the common fragmentation pathways of 4-phenylcoumarins after a detailed investigation of the mass spectra of several natural neoflavones and their synthetic analogs [131]. Neoflavones without an O-substituent in the C-2′-position give stable $[M - 28]^+$ fragments that are formed by decarboxylation. For 2′-oxygenated neoflavones, dehydroxylation or demethoxylation between the OH-5 and C-2′ substituent forms the $[M - 17]^+$ or $[M - 59]^+$ ions. These characteristic fragmentations prompted a re-examination of the structure of coutareagenin [93, 131] (Scheme 2).

The fragmentation pattern of melanein (**102**) has been reported [53]. It was assumed that the ion with *m/e* 271 is formed by loss of C_2H_3O from the molecular ion or loss of methyl from the ion with *m/e* 286 (Scheme 3).



Scheme 3

An analogous fragmentation pattern was reported for dalbergin (**28**) [63]. The molecular ion with *m/e* 268 loses the stable molecule CO_2 to form the benzofuran cation with *m/e* 240. Loss from this ion of a methyl forms a fragment with *m/e* 225. Subsequent loss of CO_2 forms a cation with *m/e* 197.



The mass spectrum of stevenin (**117**) contains an ion with *m/e* 241 that may be formed by loss of methyl from the cation with *m/e* 256 or cleavage of a C_2H_3O fragment from the molecular ion with *m/e* 284 [54].

The mass spectrum of serratin (**115**) has a characteristic molecular ion with *m/z* 254 (100%) and two strong peaks with *m/z* 226 $[M - CO]^+$ (95%) and *m/z* 197 $[M - CO - COH]^+$ (47%) [36].

A strong peak for the molecular ion with *m/z* 342 $[M]^+$ is observed in the mass spectrum of voludal (**9**). The decomposition of this ion by successive loss of two CO molecules gives fragments with *m/z* 314 $[M - 28]^+$ and *m/z* 286 $[M - 56]^+$ [17]. Ions with *m/z* 313 $[M - 29]^+$ and *m/z* 285 $[M - 57]^+$ are formed via loss of a –CHO radical and subsequent elimination of a CO molecule. A peak with *m/z* 284 $[M - 58]^+$ is formed by loss of (CHO + CO + H) from the molecular ion. A strong fragment with *m/z* 256 corresponds to loss of two methyls from the ion with *m/z* 286. Loss of a methyl and a water from the ion with *m/z* 285 $[M - 57]^+$ forms cations with *m/z* 270 $[M - 72]^+$ and *m/z* 267 $[M - 75]^+$, respectively. Fragments with *m/z* 257 $[M - 87]^+$ and *m/z* 255 $[M - 89]^+$ arise via loss of CO and two methyl radicals [17].

The FABMS spectrum of glucoside **27** contains a quasi-molecular ion with *m/z* 447 $[M - H]^-$ and a base peak with *m/z* 285 $[M - H - 162]^-$ that is formed by loss of the glucoside [10]. The spectrum of glucoside **26** exhibits an analogous quasi-molecular anion with *m/z* 461 $[M - H]^-$ and a base peak with *m/z* 299 $[M - H - 162]^-$. The difference of 14 amu is consistent with the presence in compound **26** of an additional methyl group [10]. The FABMS of glycoside **2** has a quasi-molecular anion with *m/z* 579 $[M - H]^-$, a fragment with *m/z* 447 $[M - H - 132]^-$ formed via loss of an apiofuranosyl unit, and a peak for the aglycon with *m/z* 285 [447 - 162] due to loss of the glucoside [10].

NMR SPECGTROSCOPY

Proton and carbon NMR methods can unambiguously establish the structures of neoflavones. Special investigations and analysis of ^{13}C NMR spectra of natural and synthetic neoflavones have been reviewed [28]. 4-Phenylcoumarins exhibit signals for C-2, C-3, and C-4 at 159-162, 109-113, and 155-157 ppm, respectively.

Proton NMR spectra of neoflavones typically have a 1H singlet for H-3 in the range 5.70-6.15 ppm owing to the presence of an aryl substiuent in the coumarin 4-position. A distinguishing feature of neoflavones that have unsubstituted 4-phenyls is a broad 5H singlet in the range 7.4-7.5 ppm or two multiplets at 7.3-7.4 (2H, H-2′, H-6′) and 7.4-7.5 ppm (3H, H-3′, H-4′, H-5′).

The 4-(4-methoxy)phenyl substituent is characterized by a 3H singlet for the methoxyl at 3.84-3.87 ppm and two 2H doublets (J = 8-8.7 Hz) in the ranges 6.87-6.96 (H-3′, H-5′) and 7.20-7.25 (H-2′, H-6′) ppm [11, 127]. An analogous pattern is observed with a hydroxyl in the 4′-position. The aromatic doublets resonate as doublets (J = 8-8.6 Hz) at 6.73-6.92 (H-3′, H-5′) and 7.16-7.20 (H-2′, H-6′) ppm; the hydroxyl proton, at 8.51-9.50 ppm [12, 26, 27]. For a 3,4-dioxygenated 4-phenyl substituent, splitting occurs that is typical of a three-proton ABX system. There are three signals at 6.61-6.70 ppm (dd, J = 1.8-2.2 Hz, J = 7.2-8.2 Hz, 1H, H-6′), 6.71-6.86 ppm (d, J = 1.8-2.2 Hz, 1H, H-2′), and 6.72-6.98 ppm (d, J = 7.2-8.2 Hz, 1H, H-5′) [10, 26, 30, 33, 93, 141, 142].

For 5,7-dioxygenated neoflavones, protons H-6 and H-8 resonate as two doublets with a *meta*-constant (J = 2.19-3.0 Hz) at 6.19-6.40 and 6.43-6.56 ppm, respectively [11, 24, 27, 65, 93, 127, 142]. It should be mentioned that a 7-methoxyl appears as a singlet at 3.79-3.96 ppm [11, 24, 27, 65, 93, 127] whereas a 5-methoxyl is found at 3.47-3.56 ppm [24, 27, 65, 127, 142]. This is due to the diamagnetic effect of the 4-aryl substituent. Protons H-5 and H-6 of 6,7-disubstituted 4-arylcoumarins appear as singlets at 6.79-6.98 and 7.07-7.10 ppm, respectively [30]. A singlet for H-6 in spectra of 5,7,8-trisubstituted neoflavones is observed at 6.57-6.65 ppm (DMSO-d_6) [26, 33, 141] or 6.30-6.35 ppm ($CDCl_3$) [143].

A distinguishing feature of 4-phenylcoumarins containing 3-methylbutanoic acid is the presence of a 6H doublet (J = 6.5-7.0 Hz) for the methyls at 0.9-1.08 ppm, a multitplet for the CH at 2.14-2.37 ppm, and a doublet (J = 6.5-7.0 Hz) for the methylene at 2.84-3.30 ppm [66, 67, 68, 101, 105, 110, 111, 116]. Signals at 0.88-1.04 ppm (3H, t, J = 7.0-7.5 Hz, CH_3-5), 1.12-1.32 ppm (3H, d, J = 6.5-7.0 Hz, CH_3-3), 1.30-1.50 ppm (1H, m, CH_2-4a), 1.77-1.92 ppm (1H, m, CH_2-4b), and 3.54-4.00 ppm (1H, m, H-2) are typical of a 2-methylbutanoyl moiety [5, 66, 67, 68, 101, 105, 116]. The presence of an *n*-butanoyl substituent in neoflavones gives rise to PMR signals at 0.93-1.07 ppm (3H, t, J = 7.0-7.5 Hz, CH_3-4), 1.68-1.83 ppm (2H, m, CH_2-3), and 2.98-3.34 ppm (2H, t, J = 7.0-7.5 Hz, CH_2-2) [72, 101, 117]. The 2-methylpropionyl group has a characteristic 6H doublet (J = 7.0-10.0 Hz) for the two methyls at 1.10-1.35 ppm and a multiplet for the CH groups at 3.70-3.73 ppm [67, 105, 109, 120]. PMR spectra of neoflavones with a benzoyl group in the coumarin 8-position exhibit characteristic signals at 7.45-7.51 ppm (2H, t, J = 7.4-8.0 Hz, H-3, H-5), 7.57-7.63 ppm (1H, tt, J = 7.4-8.4 Hz, J = 1.0-1.7 Hz, H-4″), and 7.65-7.89 ppm (2H, dd, J = 7.4-8.4 Hz, J = 1.0-1.7 Hz, H-2, H-6) [14, 20, 79, 80]; 6-benzoyl-4-phenylcoumarins, at 7.39-7.43 ppm (2H, m, H-3, H-5) and 7.48-7.53 ppm (3H, m, H-2, H-4, H-6) [14, 70].

Two 3H singlets at 1.63-1.94 ppm, a 2H doublet (J = 6.9-8.0 ppm) at 3.08-3.57 ppm, and a 1H doublet (J = 6.0-7.5 Hz) or triplet (J = 7.0-7.5 Hz) at 5.03-5.40 ppm indicate the presence of a prenyl group in the neoflavone [14, 21, 72, 80, 85, 105, 116, 117]. Signals at 1.81-1.95 ppm (3H, s, CH_3-5), 2.77-3.06 ppm (1H, dd, J = 7.5-8.0 Hz, J = 15.0-15.5 Hz, CH_2-1a), 3.10-3.32 ppm (1H, dd, J = 2.0 Hz, J = 15.0 Hz, CH_2-1b), 4.32-4.51 ppm (1H, d, J = 6.0-8.0 Hz, H-2), 4.86-4.93 ppm (1H, s, CH_2-4a), and 4.94-5.03 ppm (1H, s, CH_2-4b) are found in PMR spectra of 4-phenylcoumarins with a 2-hydroxy-3-methylbut-3-enyl substituent [67, 68, 72, 101].

Two 1H doublets (J = 2.0) at 7.16-7.17 ppm and 7.66-7.68 ppm in the PMR spectra of compounds **43** and **128** belong to H-3 and H-2, respectively, of the furan ring fused at the 7- and 8-positions to the coumarin [66, 72]. The diamagnetic effect of the 4-phenyl group in **48** shifts the furan signals to strong field at 6.96 and 7.31 ppm, respectively [66].

Two methyl singlets at 0.94-1.48 ppm, two 1H doublets of doublets at 2.93-3.31 ppm (J = 8.1-10.0 Hz, J = 15.0-15.5 Hz), and a 1H triplet or doublet of doublets at 4.52-4.92 ppm (J = 8.1-9.8 Hz) are characteristic of a 2,3-dihydro-2-(2-hydroxy-2-methylethyl)furan ring fused to a 4-phenylcoumarin [14, 20, 66, 101, 105].

A distinguishing feature of PMR of neoflavones containing a fused 2,2-dimethylpyran ring is the presence of two doublets (J = 9.9-11.0 Hz) for the pyran olefinic protons at 5.33-5.67 (H-3) and 6.50-6.94 ppm (H-4) [7, 5, 20, 21, 29, 70, 73-75, 79, 80, 105, 109-111, 117, 120, 138]. A 2,2-dimethyl group for 6,7- and 7,8-pyrano-4-phenylcoumarins usually gives a 6H singlet or two 3H singlets at 1.38-1.65 ppm [7, 5, 21, 29, 109, 117, 120]. These methyls for 5,6-pyranocoumarins lie in the

space over the plane of the 4-phenyl substituent. This leads to a diamagnetic shift of their signals by about 0.5-0.6 ppm, as a result of which they are observed at 0.91-1.00 ppm as a 6H singlet or two 3H singlets [5, 20, 21, 73-75, 79, 105, 110, 138]. PMR spectra of neoflavones containing fused 2,3-dimethylchromanone and 2,3-dimethylchromanol rings have been reviewed [148].

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