Communications to the Editor

Chem. Pharm. Bull.
32(1) 362—365 (1984)

NOVEL C-3/C-3''-BIFLAVANONES FROM STELLERA CHAMAEJASME L.

Guo-Quan Liu,[1)] Hiroshi Tatematsu, Mikio Kurokawa, Masatake Niwa[*]
and Yoshimasa Hirata
Faculty of Pharmacy, Meijo University, Tempaku, Nagoya 468, JAPAN

Three novel biflavanones possessing a C-3/C-3'' linkage (chamaejasmenin A, B and C) have been isolated from Stellera chamaejasme L. (Thymelaeaceae) and their structures have been elucidated on the basis of their spectral data. Chamaejasmenin B and C are the first known examples having the cis - cis configuration at the C-2/C-3 and C-2''/C-3'' positions.

KEYWORDS —— Stellera chamaejasme; Thymelaeaceae; biflavanone; chamaejasmenin A; chamaejasmenin B; chamaejasmenin C

A large number of biflavonoids have been isolated from various natural sources. But, to our knowledge of biflavonoids possessing a C-3/C-3'' linkage, only one example ("chamaejasmine") has been reported. Chamaejasmine (1) is a C-3/C-3''-flavanone isolated from Stellera chamaejasme L. (Thymelaeaceae) by Hwang and Chang in 1979.[2)] It is constructed with two units of naringenin (2).

As a part of a search for co-carcinogenic constituents in the plants of Euphorbiaceae and Thymelaeaceae, we reported the isolation of diterpenes[3)] and lignans[4)] with piscicidal activity from the roots of Stellera chamaejasme L.. Subsequently, our interest has turned to other constituents in the plant that have no piscicidal activity. As a result, we have isolated novel biflavanones possessing a C-3/C-3'' linkage. In this communication, we wish to report the isolation and structures of three C-3/C-3''-biflavanones (chamaejasmenin A, chamaejasmenin B and chamaejasmenin C).

The methanol extract (620 g) of the roots of the plant was partitioned between hexane and water. The aqueous phase was extracted with benzene. The benzene soluble fraction (8.8 g) was separated by a combination of column chromatography (silica gel, Merck 7734; $CHCl_3$-MeOH(100:3)), preparative TLC (silica gel, Whatman PLK 5F; C_6H_6-AcOEt(2:1)) and preparative HPLC (ODS, Jasco Megapak SIL-18; MeOH-H_2O(80:20)) to afford respectively chamaejasmenin A (3) (11 mg), chamaejasmenin B (4) (500 mg) and chamaejasmenin C (5) (37 mg) in addition to the lignans lirioresinol-B, pinoresinol and matairesinol.[4)] The spectral data of chamaejasmenin A, B and C are :

Chamaejasmenin A (3) as an amorphous powder: $C_{32}H_{26}O_{10}$ [m/z 570(M^+), 285]; $[\alpha]_D$ -155° (c=1.0, EtOH); λ(MeOH) 296 nm(ε 29000); ν($CHCl_3$) 3200br., 1630 cm^{-1}; δ($CDCl_3$) 2.78 (2H, d, J=12Hz), 3.84 (6H, s), 5.86 (2H, s), 5.90 (2H, d, *J*=12Hz), 5.96 (2H, s), 6.84 (4H, d, *J*=8Hz), 7.02 (4H, d, *J*=8Hz).

Chamaejasmenin B (4), mp 249 - 251°C: $C_{32}H_{26}O_{10}$ [*m/z* 570(M^+), 285]; $[\alpha]_D$ +150° (c=1.0, EtOH); λ(MeOH) 298 nm(ε 35000); ν(KBr) 3400br., 1630 cm^{-1}; δ($CDCl_3$) 2.98 (2H, s), 3.84 (6H, s), 5.32 (2H, s), 5.84 (2H, d, *J*=2Hz), 5.98 (2H, d, *J*=2Hz), 6.76 (4H, d, *J*=8Hz), 7.04 (4H, d, *J*=8Hz).

Chamaejasmenin C (5) as an amorphous powder: $C_{33}H_{28}O_{10}$ [m/z 584(M^+), 299, 285]; $[\alpha]_D$ -141° (c=1.0, EtOH); λ(MeOH) 295 nm(ε 33000); ν($CHCl_3$) 3200br., 1630 cm^{-1}; δ($CDCl_3$) 2.98 (2H, s), 3.72 (3H, s), 3.80 (6H, s), 5.28 (2H, s), 5.90 (2H, d, *J*=1.0Hz), 6.02 (2H, d, *J*=1.0Hz), 6.76 (4H, d, *J*=8Hz), 7.02 (4H, d, *J*=8Hz).

Table 1. CMR Spectra of Biflavanones and the Related Flavanones

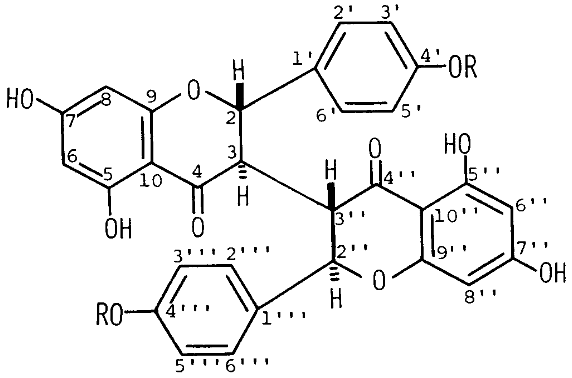
Position		3	4	5		6	7	8	9
2	2''	83.4(d)	80.4(d)	84.0(d),	84.1(d)	79.6(d)	80.2(d)	79.2(d)	78.8(d)
3	3''	49.7(d)	46.8(d)	50.3(d),	50.3(d)	43.6(t)	43.8(t)	43.2(t)	45.4(t)
4	4''	196.3(s)	196.0(s)	196.9(s),	197.7(s)	196.8(s)	197.9(s)	196.5(s)	190.9(s)
5	5''	164.0(s)	163.6(s)	164.7(s),	165.2(s)	164.7(s)	164.9(s)	164.0(s)	165.5(s)
6	6''	96.6(d)	96.3(d)	96.2(d),	97.6(d)	96.9(d)	95.7(d)	95.2(d)	96.6(d)
7	7''	166.4(s)	167.0(s)	168.5(s),	169.0(s)	167.8(s)	169.1(s)	168.3(s)	165.4(s)
8	8''	95.5(d)	95.4(d)	94.5(d),	95.8(d)	96.1(d)	95.0(d)	94.4(d)	93.7(d)
9	9''	162.9(s)	163.0(s)	163.3(s),	163.6(s)	164.1(s)	164.3(s)	163.3(s)	163.0(s)
10	10''	102.6(s)	102.7(s)	102.9(s),	103.7(s)	103.0(s)	103.8(s)	103.3(s)	105.1(s)
1'	1'''	128.8(s)	127.9(s)	129.3(s),	129.3(s)	131.5(s)	130.7(s)	130.8(s)	131.1(s)
2'	2'''	129.2(d)	127.1(d)	129.9(d),	129.9(d)	128.4(d)	128.9(d)	128.0(d)	127.9(d)
3'	3'''	114.3(d)	114.1(d)	114.7(d),	114.7(d)	114.7(d)	116.3(d)	114.4(d)	114.3(d)
4'	4'''	160.4(s)	159.2(s)	160.9(s),	160.9(s)	160.7(s)	158.7(s)	160.2(s)	160.1(s)
5'	5'''	114.3(d)	114.1(d)	114.7(d),	114.7(d)	114.7(d)	116.3(d)	114.4(d)	114.3(d)
6'	6'''	129.2(d)	127.1(d)	129.9(d),	129.9(d)	128.4(d)	128.9(d)	128.0(d)	127.9(d)
OMe		55.5(q)	55.3(q)	55.4(q),	55.4(q)	55.6(q)	56.1(q)	55.4(q)	55.5(q)
				55.8(q)				55.8(q)	55.9(q)

In addition to the mass spectra, their PMR spectra, in which only half of the total protons were observed, show that chamaejasmenin A (3) and chamaejasmenin B (4) both have molecular structures with a symmetrical character, as seen in chamaejasmine (1). However, they have large $[\alpha]_D$ values in the optical rotation, indicating that both 3 and 4 have no symmetrical plane and the free rotation of the single bond between C-3 and C-3'' seems to be sterically restricted. As judged from the CMR spectra in Table 1 (3; 49.7(d) and 114.3(d), 4; 46.8(d) and 114.1(d), 6; 43.6(t) and 114.7(d), 7; 43.8(t) and 116.3(d)), both 3 and 4 have the structure dimerized at the C-3 position of the two 4'-methylnaringenin molecules (6). Moreover, 3 and 4 both have four asymmetric carbons (C-2, C-3, C-2'' and C-3'') in

NII-Electronic Library Service

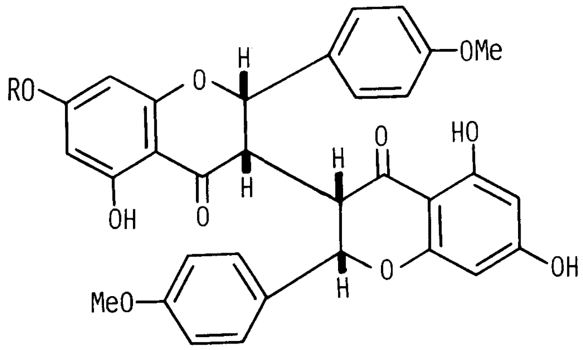
the molecule. The stereochemistry at the C-2/C-3 and C-2''/C-3'' positions were determined by comparison of the *J*-values of the corresponding protons (3; 12 and 12Hz, 4; 0 and 0Hz[5]). Namely, 3 has the geometry of *trans* - *trans* and 4 has the geometry of *cis* - *cis*.

Chamaejasmenin C (5) is regarded as a monomethyl ether of chamaejasmenin B (4) on the basis of the following spectral data: m/z 299 and 285, δ 3.72(3H,s) and 3.80 (6H,s). Two methoxy groups are present at the C-4' and C-4''' positions (δ 114.4) and the one remaining methoxy group is located at the C-7 position, as judged from the chemical shifts of the C-4 and C-10 carbons (5; 196.9 or 197.7 and 102.9 or 103.7, 6; 196.8 and 103.0, 7; 197.9 and 103.8, 8; 196.5 and 103.3, 9; 190.9 and 105.1). The stereochemistry at the C-2/C-3 and C-2''/C-3'' positions (δ 2.98(2H,s) and 5.28(2H,s)) has the same *cis* - *cis* geometry as chamaejasmenin B (4).



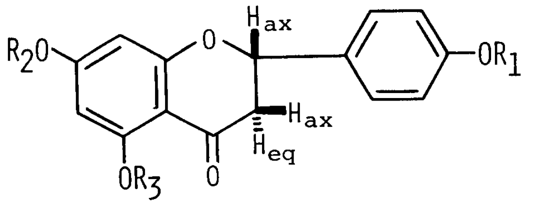
1) R = H or its antipode

3) R = Me or its antipode



4) R = H or its antipode

5) R = Me or its antipode



2) $R_1 = R_2 = R_3 = H$

6) $R_1 = Me$, $R_2 = R_3 = H$

7) $R_2 = Me$, $R_1 = R_3 = H$

8) $R_1 = R_2 = Me$, $R_3 = H$

9) $R_1 = R_3 = Me$, $R_2 = H$

As mentioned above, the structures of chamaejasmenin A, B and C should be represented as **3**, **4** and **5**, respectively. Especially, **4** and **5** are the first examples of C-3/C-3''-biflavanone having the *cis* - *cis* geometry at the C-2/C-3 and C-2''/C-3'' positions. But, the chirality at C-3/C-3'' of **3**, **4** and **5** remains uncertain.

ACKNOWLEDGEMENT This work was supported in part by a Grant-in-Aid for scientific research (grant NO. 58540344) from the Ministry of Education, Science and Culture of Japan, and is gratefully acknowledged.

REFERENCES AND NOTES

1) Present address ; Institute of Chemistry, Chinese Academy of Science, Beijing, China.

2) W.-K.Hwang and C.-C.Chang, K'o Hsueh Tung Pao, **24**, 24 (1979) [C. A., **90**, 135086m (1979)]. Prof. Hwang was killed in a tragic airplane accident in 1982. We express our regret over his death. The PMR and Mass spectral data of chamaejasmine reported in his paper is shown here: δ(acetone-d_6) 2.97(2H,d,*J*=12Hz), 5.84 - 5.99(6H,m), 6.85 and 6.99(total 8H,d,*J*=9Hz), 11.23(2H,s); *m/z* 542(M^+), 271.

The stereochemistry of C-2/C-3 and C-2''/C-3'' is trans and that of C-3/C-3'' is uncertain.

3) M.Niwa, H.Takamizawa, H.Tatematsu and Y.Hirata, Chem. Pharm. Bull., **30**, 4518 (1982).

4) H.Tatematsu, M.Kurokawa, M.Niwa and Y.Hirata, Chem. Pharm. Bull., accepted.

5) H.D.Locksley, Progress in the Chemistry of Organic Natural Products, **30**, 208 (1973). H_{C-2}(axial) - H_{C-3}(axial) = 12Hz, H_{C-2}(axial) - H_{C-3}(equatorial) = 3.5 Hz in naringenin(2).

(Received October 19, 1983)