Crotaramosmin, a New Prenylated Flavanone from Crotalaria ramosissima

Md. Khalilullah, V. M. Sharma, P. S. Rao, and K. Raghava Raju

J. Nat. Prod., **1992**, 55 (2), 229-231• DOI:
10.1021/np50080a013 • Publication Date (Web): 01 July 2004

Journal of Natural Products
Vol. 55, No. 2, pp. 229-231, February 1992

CROTARAMOSMIN, A NEW PRENYLATED FLAVANONE FROM *CROTALARIA RAMOSISSIMA*

MD. KHALILULLAH, V.M. SHARMA, P.S. RAO,* and K. RAGHAVA RAJU

Department of Chemistry, Kakatiya University, Warangal, 506 009 Andhra Pradesh, India

ABSTRACT.—Crotaramosmin [**1**], a new monoprenylated flavanone (5,4′-dihydroxy-6-prenylflavanone), has been characterized from *Crotalaria ramosissima*.

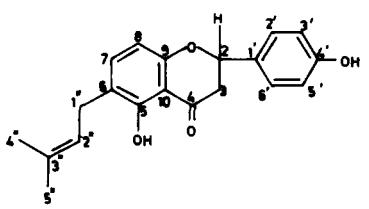
The genus *Crotalaria* (Leguminosae) is a rich source of flavanoid pigments. Flavanones are known to co-occur with their precursors, chalcones. Investigation of *Crotalaria ramosissima* Roxb., hitherto chemically unexplored, has led to the isolation and characterization of a new flavanone named cortaramosmin [**1**].

Compound **1**, which analyzed for $C_{20}H_{20}O_4$, absorbed in the uv at 227, 235 (sh), 254 (sh), 268, and 312 nm, indicating a flavanone pattern (1). In addition, **1** gave color reactions with 50% NaOH and concentrated H_2SO_4. The red shift in band-I absorption observed in the presence of NaOMe and $AlCl_3$/HCl gave evidence for a 4′-OH and 5-OH. A bathochromic shift in band II in NaOAc confirmed the presence of a 5-OH (2). The ir absorptions at 1640, 1355, and 1450 cm^{-1} are due to the flavanone carbonyl, a gem dimethyl group, and the olefinic double bond, respectively. **1** gave a brown coloration with neutral $FeCl_3$. Oxidation of **1** with alkaline $KMnO_4$ gave *p*-hydroxybenzoic acid, thus ruling out the presence of any other substitution in the B ring.

The ^1H nmr of **1** contained an intense singlet at 1.43 ppm integrating for six protons. The absorption range and the ir bands suggested the presence of the gem dimethyl group of a prenyl unit. A clear ABX pattern (3) absorption for flavanone C-2 and C-3 protons could not be observed because of overlapping of the prenyl absorptions. The methylene unit of the dimethylallyl function appeared along with the flavanone hydrogen on C-3 as a multiplet centered around 3.05 ppm. The signal of H-2 merged with the olefinic hydrogen of the prenyl group at 5.5 ppm. An A_2B_2 pattern of two ortho-coupled doublets at 7.01, 7.12, and 6.68–6.77 ppm (J = 8.5 Hz) confirmed a 4′-hydroxy substituted B ring (4). Another doublet with ortho coupling (J = 8.8 Hz) integrating for one hydrogen each at 6.24–6.35 and 7.44–7.55 ppm appeared for H-7 and H-8, respectively. A chelated hydroxyl and ortho coupling of two A-ring hydrogens established the position of the prenyl function at C-6. A D_2O exchangeable singlet at 6.79 ppm was assignable to the 4′-OH. Owing to chelation, the 5-OH resonated at 13.03 ppm. From the ^1H-nmr data, **1** was identified as 5,4′-dihydroxy-6-prenylflavanone and named crotaramosmin.

The new flavanone formed a diacetate, as evidenced by its ^1H-nmr spectrum which exhibited two singlets for the two acetoxyls at 2.13 and 2.8 ppm. The downfield absorption might be due to the C-5 acetoxyl's experiencing the deshielding effect of the carbonyl group.

In the eims, the molecular ion signal appeared at *m/z* 324. The base peak ion, appearing at *m/z* 309, was due to loss of an Me group from the prenyl group. A



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retro-Diels-Alder type of fragmentation was responsible for the signals at *m/z* 204 and 120. The former serves as a precursor to many prominent ions including *m/z* 203, 187, and 161.

The structure of **1** was confirmed by the ^{13}C-nmr spectrum, which indicated the presence of one prenyl group and three oxygenated aromatic carbons in a flavanone skeleton. The signal assignments are based on the values for model compounds.

A literature survey revealed that **1** is isomeric with bavachin and isobavachin isolated from *Psoralea corylifolia* (5). An outstanding difference found in the case of the new flavanone **1** is the absence of a ^{1}H-nmr downfield signal (6) in the range 7.8–8.10 ppm for the presence of the H-5. The structure of flavanone **1** with a 5-hydroxyl group and 4-hydroxylated B ring, should have the prenyl group in the A ring either on C-6 or C-8. A structure with a C-5 hydroxyl and a C-8 prenyl function was ruled out on biogenetic considerations (5).

EXPERIMENTAL

GENERAL EXPERIMENTAL PROCEDURES.—The mp's reported were determined on a Boitus micro mp apparatus and are uncorrected. The ir and uv spectra were recorded on a Perkin-Elmer 253 instrument and a Shimadzu MPS-5000 spectrophotometer, respectively. DMSO-d_6 and $CDCl_3$ were used as solvents for determining ^{1}H nmr of **1** and its acetate, respectively, on a Perkin-Elmer-90 MHz instrument. The ^{13}C-nmr spectrum was recorded in DMSO-d_6 on a Bruker spectrospin instrument (20.15 MHz). The eims was obtained on an Associated Electrical Industrial (AEI-Ms-d) double focusing mass spectrometer.

PLANT MATERIAL.—The plant material was collected in the Tadwai forest of the Warangal District in Andhra Pradesh. A voucher specimen was identified by Dr. V.S. Raju, Department of Botany, Kakatiya University, and was deposited in the Herbarium of Natural Products Research Laboratory, Kakatiya University under number 5.

ISOLATION OF CROTARAMOSMIN [**1**].—Freshly collected plant material (500 g) was soaked in petroleum ether 60–80° (2.5 liters), for 4 days. The extract was freed from plant material, concentrated under reduced pressure, and kept in a refrigerator for a few days when a pale yellow crystalline solid (0.3 g) deposited. The supernatant solution was removed, and the solid was dissolved in a minimum amount of MeOH and poured on a Si gel column (50 g) containing a layer of charcoal (2 g) on top. The column was eluted with MeOH, and the eluate on concentration and subsequent cooling gave colorless crystals of **1**: mp 116°; elemental analysis found C 73.8, H 6.1, $C_{20}H_{20}O_4$ requires C 74.07, H 6.1%; uv λ max (MeOH) (log ε) 227 (2.8), 235 (sh), 254 (sh), 268 (3.8), 312 (4.0); (NaOMe) 243, 268, 322 (sh), 382; ($AlCl_3$ and $AlCl_3$/HCl) 228, 270, 337, 370, 450 (sh); ir ν max (Nujol) 3400 (br), 1640 (C=0), 1600, 1450, 1355, 970; ^{1}H nmr ($CDCl_3$, 90 MHz) 1.43 (6H, s, gem dimethyl group), 2.9 (2H, m, H-3 of flavanone ring), 3.22 (2H, br s, benzylic), 5.06 (1H, t, olefinic), 5.43 (1H, m, H-2 of flavanone), 6.24–6.35 (1H, d, J = 8.8 Hz, H-7), 7.44–7.55 (1H, d, J = 8.8 Hz, H-8), 6.68–6.77 (2H, d, J = 8.5 Hz, H-3′, -5′), 7.01–7.12 (2H, d, J = 8.5 Hz, H-2′, -6′), 6.8 (1H, s, 4′-OH), 13.03 (1H, s, 5-OH); eims *m/z* (%) 324 (18), 309 (100), 291 (9), 281 (2), 217 (4.5), 204 (9), 203 (40), 202 (2.7), 187 (13.5) 176 (2), 162 (2), 161 (7), 160 (4.5), 155 (3.6), 149 (3.8), 132 (4.0), 131 (3.6), 120 (2), 115 (2.7), 107 (18), 103 (3.6), 91 (2.7), 77 (9), 75 (1.8), 55 (3.6); ^{13}C nmr see Table 1.

TABLE 1. ^{13}C-nmr Chemical Shifts of Crotaramosmin [**1**].

Carbon	Chemical Shift[a]	Carbon	Chemical Shift
C-2	76.483	C-1′	129.474
C-3	39.739	C-2′, -6′	128.756
C-4	204.268	C-3′, -5′	115.927
C-5	159.968	C-4′	158.304
C-6	108.39	C-1″	22.561
C-7	133.069	C-2″	130.62
C-8	108.839	C-3″	127.777
C-9	159.823	C-4″	24.781
C-10	112.914	C-5″	22.561

[a]Absorptions in ppm from proton-decoupled spectrum.

CROTARAMOSMIN ACETATE.—The acetate was prepared from 100 mg of **1** using Ac_2O (5 ml) and pyridine (0.5 ml) by refluxing on a steam bath for 6 h. The acetate separated from EtOAc-petroleum ether (1:3) as colorless crystals: mp 136°; elemental analysis found C 69.8, H 5.5, $C_{24}H_{24}O_6$ requires C 70.5 H 5.8; ^1H nmr ($CDCl_3$, 90 MHz) 1.26–1.35 (6H, s, gem dimethyl group), 2.8 (2H, m, benzylic), 5.22 (1H, m, olefinic), 2.13 (3H, s, acetoxyl), 2.82 (3H, singlet merged, acetoxyl), 3.33 (2H, m, H-3), 5.32 (1H, m, H-2), 6.36–7.16 (6H, unresolved doublets, H-7, H-8; H-2′, -6′; H-3′, -5′).

OXIDATION OF **1**.—The flavanone was oxidized with 2% aqueous $KMnO_4$ solution in the presence of 2% KOH by heating over a steam bath (4 h). Usual workup gave an acid identified as *p*-hydroxybenzoic acid (mmp).

ACKNOWLEDGMENTS

One of the authors (VMS) is thankful to CSIR (Delhi) for the award of a junior research fellowship. The authors thank Mr. W. Banerjee, D.F.O., Wild Life Sanctuary, Tadwai, for help in the collection of the plant material.

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Received 1 January 1991