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CENTRATHERIN, A NEW GERMACRANOLIDE FROM *CENTRATHERUM PUNCTATUM*

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Key Word Index—*Centratherum punctatum*; Vernonieae; Compositae; germacranolide; sesquiterpene lactone.

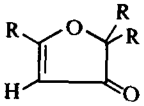
INTRODUCTION

In connection with a biochemical systematic investigation of the genus *Centratherum*, we describe the isolation and structure determination of a new heliangolide, centratherin (**1a**), from the chloroform extract of *Centratherum punctatum* Cass. from Brazil. The only previous work on this species reported an acetylene typical of many members of the Tribe Vernonieae, namely, pentayene.

RESULTS

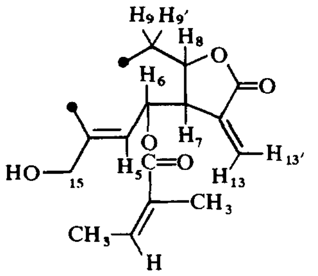
Centratherin (**1a**), $C_{20}H_{22}O_7$ (high resolution MS; calc. 374.1365; found 374.1370), mp 105–110°, contains an α-methylene-γ-lactone (IR bands at 1760 and 1660 cm^{-1} and typical PMR signals at δ 6.27 and 5.52). A primary allylic hydroxyl group was indicated by IR bands at 3250 cm^{-1} and in the PMR spectrum by a broadened two-proton triplet at δ 4.43.

An angelic ester function was suggested by the presence of an α,β-unsaturated ester band at 1715–1720 cm^{-1} and a broadened PMR signal for a vinyl proton centred at δ 6.2. The latter signal showed coupling with two vinyl methyl signals (at δ 1.80 and 1.90) and exhibited a chemical shift and coupling similar to those observed for the vinyl proton in the angelic ester group in eupatundin and eupatoroxin [2]. IR bands at 1690, 1640 and 1580 cm^{-1} and a sharp PMR singlet at δ 5.86 suggested the presence of a 3-(2H)-furanone moiety [3] in centratherin:

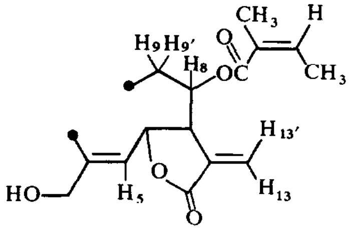


The presence of α-methylene-γ-lactone, an angelic ester, a primary allyl alcohol and a 3-(2H)-furanone moiety account for all the seven oxygen functions and nine of the ten degrees of unsaturation indicated by the empirical formula of centratherin. The remaining degree of unsaturation is in accord with a germacranolide skeleton.

Extensive decoupling experiments established the relative positions of all functions. Irradiation on the H-7 multiplet at δ 3.85 collapsed the two doublets for H-13 and H-13′ into two sharp singlets; in addition, the double triplet at δ 4.58 for H-8 became a double doublet. Irradiation at δ 4.58 ppm (H-8) changed the complex AB part of an ABX system into a simple AB quartet indicating that the two double doublets at δ 2.30 and 2.58 ppm are for H-9 and H-9′. The broadened triplet at δ 4.43 was assigned to the allylic protons at C15 since after this signal was irradiated, H-5 at δ 6.32 (*dt*) appeared as a sharp doublet and the broad multiplet for H-6 at δ 5.48 was also sharpened. When considered together with the IR data these decoupling experiments provide partial structures **2a** or **2b**:

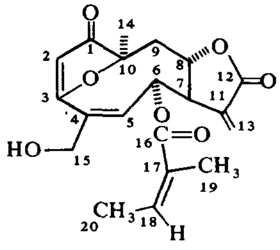


2a

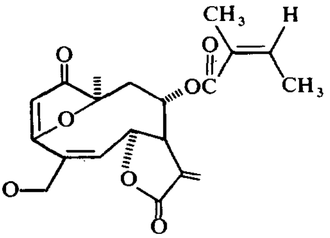


2b

Combining these partial structures with a 3-(2H)-furanone and a methyl group geminal to an oxygen function (δ1.55) suggested structures **1a** or **1b** for centratherin.

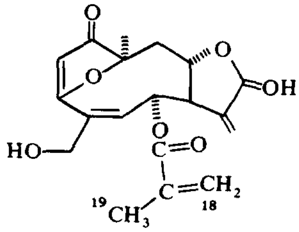


1a Centratherin



1b Budlein-A

Since structure **1b** corresponds to budlein-A[4], **1a** can be considered for centratherin. In addition, centratherin has chemical shifts and coupling constants similar to those observed [5] for goyazensolide (**3**) (see Table 1), a germacranolide which differs from **1a** only in the nature of the side chain ester moiety. The stereochemistry of goyazensolide was proposed from PMR coupling constants and the presence of an NOE between H-5 and H-15[5]. Since the coupling constants in the PMR of centratherin (**1a**) are similar to those reported for goyazensolide, we propose the same sterochemistry for centratherin. An X-ray analysis of centratherin is now in progress to confirm the proposed structure and relative stereochemistry and to establish the absolute structure.



3 Goyazensolide

Table 1. PMR spectral data for centratherin (**1a**) and goyazensolide (**3**)

	(1a)*			(3)†		
	δ ppm	Multiplicity	J (Hz)	δ ppm	Multiplicity	J (Hz)
H-2	5.86	*s*		5.83	*s*	
H-5	6.32	*dt*	1.5, 1.5	6.27	*dt*	~ 1.5, ~ 1.5
H-6	5.48	*m*	1.5, 1.5, ~ 2.5	5.33	*dt*	~ 2.5, ~ 1.3
H-7	3.85	*m*	3, 3, 3, ~ 2.5	3.80	*m*	3.3, 3, 2.5, 2.5
H-8	4.58	*dt*	10, 3, 3	4.53	*dt*	2.5, 13
H-9′	2.30	*dd*	13, 10	2.30	*dd*	15, 2.5
H-9′	2.58	*dd*	13, 3	2.50	*dd*	15, 3
H-13′	5.52	*d*	3	5.49	*d*	3
H-13′	6.27	*d*	3	6.22	*d*	3.3
15-CH_3	1.55			1.52		
14-CH_2O—	4.43	*brt*	1.5, 1.5	4.38	*br*	~1.5, ~1.3
H-18	6·2	*m*	1, 2, 8			
19-CH_3	1.80	*m*	2	1.83	*m*	
20-CH_3	1.90	*dq*	1, 8			
18-CH_2=C				6.02	*br*	1

*Recorded in $CDCl_3$ on a Varian-HA-100 with TMS as internal standard.

†Recorded in $CDCl_3$ on a Bruker-HFX-270 with TMS as internal standard; from Herz *et al.* [5].

EXPERIMENTAL

The mp is uncorr. UV spectra were measured in MeOH and ^{1}H NMR were recorded on a Varian HA-100 instrument in $CDCl_3$ with TMS as internal reference.

Extraction and isolation. Leaf and stem material of *Centratherum punctatum* (250 g), (collected between São Paulo and Rio de Janeiro, Brazil in February 1976; collection sp. Jones 76-56; a voucher is deposited in the Herbarium, University of Georgia) was extracted once with $CHCl_3$ and worked up in the usual manner [6]. The resulting syrup (1 g) was chromatographed on a Si gel column, eluting with $CHCl_3$–MeOH (40:1). Fractions from the column were checked by TLC, combined and dried under N_2 atmosphere.

The initial series of combined fractions were further separated on Si gel thick-layer plates with a C_6H_6–MeOH (18:1) solvent system. The plates were developed sequentially 3 ×. The major band was eluted with Et_2O; the soln was dried and the resultant material recrystallized from EtOAc to give centratherin (30 mg), mp 105–110°; UV λ_{max} 267, 217 (ε 7435, 10500); IR bands as 3250, 2720, 1760, 1715, 1660, 1580, 1220 cm^{-1}; MS *m/e* (relative intensity): 374 (M$^+$) (8), 356 (5), 291 (6), 274 (7) and 83 (100; for angelic acid moiety).

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