Journal of Natural Products
Vol. 52, No. 4, pp. 861-863, Jul-Aug 1989

ODONTIN AND ODONTICIN, TWO NEW EUDESMANE SESQUITERPENES FROM *PLUCHEA ARGUTA*

VIQAR UDDIN AHMAD,* KANIZ FIZZA, and AZIZ-UR-RAHMAN AMBER

H.E.J. Research Institute of Chemistry, University of Karachi, Karachi 32, Pakistan

ABSTRACT.—Two new eudesmane sesquiterpenes, odontin [**1**] and odonticin [**2**], were isolated from the whole plant of *Pluchea arguta*. The structures were assigned on the basis of spectroscopic studies.

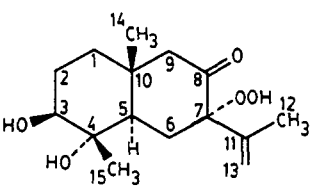
Previous work (1,2) on the whole plant of *Pluchea arguta* Boiss. (syn. *Conyza odontophylla* Boiss.) (Compositae) resulted in the isolation of 4-*epi*-plucheinol and arguticin in addition to some known compounds. We have now examined the polar fractions of the hexane extract and have obtained two new eudesmanes, odontin [**1**] and odonticin [**2**], possessing hydroperoxide groups at the 7α and 11 positions, respectively.

RESULTS AND DISCUSSION

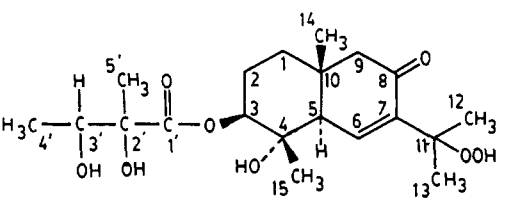
ODONTIN [**1**].—$[\alpha]^{20}D$ −180° (*c* = 0.04, MeOH), $C_{15}H_{24}O_5$, $[M]^+$ 284.1625; ir ($CHCl_3$) ν max 3400 (hydroxyl), 1710 (ketone) cm^{-1}. The presence of a hydroperoxide group was indicated by the loss of H_2O_2 from the molecular ion in the mass spectrum (2,5) and by the presence of a one-proton singlet at δ 7.89 in the ^{1}H-nmr spectrum (5). The position of the hydroperoxide group was deduced by the low field shift of H-5 at δ 2.91, which clearly indicated the 7α hydroperoxide (5). This was also confirmed by the low field shift of the methyl singlet at δ 1.91 assigned for Me-12.

In the ^{1}H-nmr spectrum, signals δ 5.18 and 5.19 were assigned to olefinic exomethylene protons of an isopropenyl side chain. A doublet of doublets centered at δ 3.66 (J = 4.2, 10.4 Hz), characteristic for a proton geminal to an equatorial alcohol, was assigned to H-3α. The two hydroxyls are vicinal, but must be trans as no acetonide is formed when **1** is treated with *p*-toluenesulfonic acid in anhydrous Me_2CO. The stereochemistry at C-4 was deduced on the basis of the chemical shift of Me-15 at δ 1.22 characteristic for an α-oriented OH. In lactones with a 4-βOH the Me-15 is shifted upfield (3). The C-9 methylene protons resonated at δ 2.84 and at δ 2.85 as a doublet of 10 Hz and as a multiplet, respectively, the downfield shift being due to the presence of 7α-hydroperoxide group. The C-6 methylene protons resonate as a doublet of doublets at δ 2.23 with coupling constants of 5.4 and 10 Hz. The ^{13}C-nmr measurements were in agreement with the proposed structure (Table 1).

The field desorption mass spectrum, as well as negative ion fabms, exhibited the molecular ion *m/z* 284, while the hrms showed exact mass measurement *m/z* 284.1621 corresponding to the molecular formula $C_{15}H_{24}O_5$. An important peak appeared at *m/z* 250.1566 (100%) (base peak) attributable to the



1



2

TABLE 1. ^{13}C-Nmr shifts of Odontin [**1**] and Odonticin [**2**] ($CDCl_3$, 75.4 MHz, ppm).[a]

Carbon	Compound		Carbon	Compound	
	1	**2**		**1**	**2**
C-1	37.00	32.75	C-11	141.12	74.41
C-2	27.42	24.03	C-12	19.89	29.64
C-3	79.01	78.93	C-13	111.84	28.82
C-4	74.58	72.31	C-14	18.84	18.96
C-5	53.14	48.92	C-15	22.71	22.40
C-6	29.41	142.55	C-1′		171.15
C-7	80.64	145.06	C-2′		72.10
C-8	208.20	200.87	C-3′		72.45
C-9	52.59	57.75	C-4′		18.42
C-10	38.34	39.19	C-5′		19.21

[a]Status of each carbon confirmed through DEPT experiment.

fragment $C_{15}H_{22}O_3$ due to the loss of H_2O_2 from the molecular ion. Another peak appeared at *m/z* 209.1174 (12%), which corresponded to the formula $C_{12}H_{17}O_3$ and must be due to the loss of the isopropenyl side chain from the molecule. Odontin [**1**] is therefore a new 3-*epi*-cuauthemone (5) derivative having a 7α-hydroperoxide with an isopropenyl side chain.

ODONTICIN [**2**].—$[\alpha]^{20}D$ +178° (*c*= 0.01, MeOH), $C_{20}H_{32}O_8$, $[M]^+$ 400.2094; uv (MeOH) λ max 237 (log ε 3.422) nm; ir ($CHCl_3$) ν max 3350 (hydroxyls), 1740 (saturated ester), and 1650 (α,β-unsaturated ketone) cm^{-1}. The ^{1}H nmr showed a downfield singlet at δ 7.78, which was assigned to a hydroperoxide proton integrated for one proton. The position of the hydroperoxide group was deduced from the chemical shift of the corresponding geminal methyl groups at C-11, which shifted downfield and resonated at δ 1.48 and 1.49. This was also confirmed by a slightly downfield shift of the olefinic proton, which resonated at δ 7.25 instead of δ 7.05 as in plucheinol (4). The presence of the hydroperoxide in **2** was also confirmed by the loss of H_2O_2 in the mass spectrum (2,5). The chemical shift of H-3 at δ 5.07 as a doublet of doublets with coupling constants of 3.8 and 10.2 Hz suggested the presence of an ester group attached to the C-3β position. The stereochemistry at C-3 was supported by the multiplicity and coupling constants of the H-3 signal (dd, J= 3.8 and 10.2 Hz), while the stereochemistry at C-4 was assigned on the basis of the chemical shift of Me-15, δ 1.23, and the olefinic H-6 at δ 7.25. The H-5α which resonated at δ 2.78 as a doublet with a coupling constant of 3.5 Hz showed a *trans*-fused decaline as in plucheinol (4,6). The remaining signals at δ 3.98 (q, J= 6 Hz), 1.37 (s), and 1.25 (d, J= 6 Hz) were assigned respectively to the H-3′, H-5′, and H-4′ in a 2′,3′-dihydroxy-2′-methylbutyryl group (6). The multiplicities of proton signals were determined through the 2D-*J*-resolved spectrum, while coupling interactions were established by a COSY-45 experiment. A NOESY spectrum served to show the spatial connectivities in the molecule. The nOe interaction of Me-14 with CH_2-9 could be observed. Similarly the nOe interaction between the C-6 olefinic proton and Me-13 was also observed. Spatial nOe interactions between Me-5′ and H-3′ in the side chain could also be observed. ^{13}C-nmr measurements were in full agreement with the proposed structure **2**.

The negative ion fabms showed an $[M]^+$ at *m/z* 400, while the hrms exhibited exact mass measurements, *m/z* 400.2094, corresponding to the

molecular formula $C_{20}H_{32}O_8$. An important peak appeared at *m/z* 284.1622 (42%) which was in agreement with the formula $C_{15}H_{24}O_5$ and indicated the loss of an ester side chain from the molecular ion. Another peak appeared at *m/z* 250.1566 (71%), which was attributed to the formula $C_{15}H_{22}O_3$. This suggested the loss of H_2O_2 from ion *m/z* 284 indicating the presence of hydroperoxide. The proposed structure for odonticin [**2**] is 3β-(2′,3′-dihydroxy-2′-methylbutyryloxy)-4α-hydroxy-11-hydroperoxy-6,7-dehydroeudesman-8-one.

EXPERIMENTAL

The uv spectra were scanned on a Shimadzu UV 240 spectrophotometer. Ir spectra were obtained on a JASCO A-302 spectrophotometer. The ^{1}H-nmr spectra were recorded on a Bruker AM 300 Nuclear Magnetic Resonance spectrometer. The ^{13}C-nmr spectra were recorded at 75.4 MHz. The chemical shifts are expressed as ppm. The mass spectra were measured on Varian MAT-112 and MAT-312 spectrometers connected to an MAT-188 data system and PDP 11/34 computer system. Optical rotation was measured on a Polartronic-D polarimeter. Flash cc was performed on Eyela Flash chromatography EF-10 model, using Si gel 60, 230–400 mesh size (E. Merck). The purity of the sample was confirmed by hptlc Si gel 60 F_{254} precoated glass plates (nano tlc; E. Merck).

PLANT MATERIAL.—Fresh plant material of *P. arguta* (10 kg) was collected in August 1985 from Karachi and identified by members of the Department of Botany, University of Karachi. A voucher specimen has been deposited in the Herbarium of the Botany Department, University of Karachi.

EXTRACTION AND ISOLATION.—The fresh whole plant was soaked in hexane and homogenized with an Ultra-Turrax homogenizer. The hexane extract after evaporation of solvent in vacuo afforded a greenish gummy mass that was chromatographed on a large Si gel column (Si gel 60, 70–230 mesh) with solvents of increasing polarity in the order hexane, hexane/$CHCl_3$, $CHCl_3$, $CHCl_3$/EtOAc, EtOAc, EtOAc/MeOH, and MeOH. Fractions eluted with $CHCl_3$-EtOAc (40:60) afforded a sesquiterpene mixture. This sesquiterpene mixture was subjected to repetitive flash cc using $CHCl_3$-Me_2CO (60:40) as eluent. The last few fractions afforded pure odontin [**1**] (40 mg) as a colorless gum. The purity of **1** was confirmed on hptlc [$CHCl_3$-MeOH (8:2)]. The first few fractions, which were not pure, were subjected to short cc (Si gel) with $CHCl_3$-Me_2CO (70:30) and furnished pure odonticin [**2**] (52 mg) as an oil. The purity of **2** was also confirmed on hpltc [$CHCl_3$-MeOH (8.7:1.3)].

Odontin [**1**] was obtained as a colorless gum: ^{1}H-nmr (400 MHz, $CDCl_3$) δ 0.96 (s, 3, Me-14), 1.22 (s, 3H, Me-15), 1.44 (ddd, 1H, J = 14, 14, 3.5 Hz, H-1α), 1.74 (m, 1H, H-2α), 1.91 (s, 3H, Me-12), 2.23 (dd, J = 5.4 Hz, 10 Hz, 2H, H-6), 2.30 (m, 1H, H-2β), 2.84 (d, J = 10 Hz, 1H, H-9β), 2.85 (overlapped m, 1H, H-9α), 2.91 (dd, J = 5.4 Hz, H-5α), 3.66 (dd, J = 4.17 Hz, 10.38 Hz, 1H, H-3α), 5.18 (br s, 1H, H-13), 5.19 (br s, 1H, H-13), 7.89 (s, 1H, OO*H*).

Odonticin [**2**] was obtained as a syrup: ^{1}H-nmr (300 MHz, $CDCl_3$) δ 0.99 (s, 3H, Me-14), 1.23 (s, 3H, Me-15), 1.25 (d, J = 6 Hz, 3H, Me-4′), 1.37 (s, 3H, Me-5′), 1.48 (s, 3H, Me-13), 1.49 (s, 3H, Me-12), 2.32 (m, 2H, Me-9), 2.78 (d, J = 3 Hz, 1H, H-5α), 3.98 (q, J = 6.5 Hz, 1H, H-3′), 5.07 (dd, J = 3.8 Hz, 10.2 Hz, 1H, H-3α), 7.25 (d, J = 3.5 Hz, 1H, H-6), 7.78 (s, 1H, OO*H*).

LITERATURE CITED

1. V.U. Ahmad and K. Fizza, *Phytochemistry*. **25**, 949 (1986).
2. V.U. Ahmad and K. Fizza, *Liebigs Ann. Chem.*, 643 (1987).
3. F. Bohlmann, N. Borthakur, H. Robinson, and R.M. King, *Phytochemistry*. **21**, 1795 (1982).
4. M.T. Chiang, M. Bittner, M. Silva, W.H. Watson, and P.G. Sammes, *Phytochemistry*. **18**, 2033 (1979).
5. F. Bohlmann, M. Wallmeyer, J. Jakupovic, T. Gerke, R.M. King, and H. Robinson, *Phytochemistry*. **24**, 505 (1985).
6. F.J. Arriaga and J.B. Castillo, *Planta Med.*, 290 (1985).

Received 14 November 1988