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Two New Sesquiterpenes from *Pluchea arguta*

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Abstract – Two new sesquiterpenes, 3′-chloro-2′-hydroxy-3-epi-arguticinin (**1**) and argutenol (**2**) belonging to eudesmane and gorgonane classes respectively, have been isolated from *Pluchea arguta.* Their structures were elucidated with the help of sophisticated spectroscopic techniques including nOe difference and NOESY experiments.

Key words – Sesquiterpenes, eudesmane and gorgonane derivatives, *Pluchea arguta,* Compositae.

Introduction

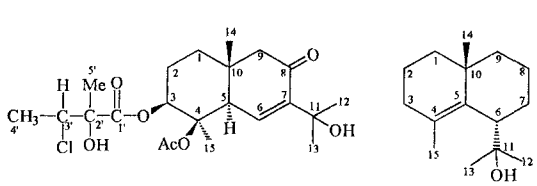
Pluchea arguta Boiss (syn. *Conyza odontophyll* Boiss) grows as a common weed in Sindh and other areas of Pakistan (Nasir and Ali, 1972). Some *Pluchea* species are important for their medicinal properties (Mukhopadhyay and Cordell, 1983), and constituents (Bohlman and Mahanta, 1978, Chiang *et al*, 1979, Nakanishi *et al*, 1974). A number. of sesquiterpenes have already been reported by us from *Pluchea arguta* (Ahmad *et al*, 1992a). This communication describes the isolation and characterzation of two new sesquiterpenes : 3′-chloro-2′-hydroxy-3-epi-arguticinin (**1**) and argutenol (**2**) belonging to eudesmane and gorgonane classes, respectively. Their structures were elucidated with the help of sophisticated spectroscopic tecniques including nOe difference and NOESY experiments.

Experimental

General Experimental Procedures. The melting point was uncorrected and taken on a Büchi 535 apparatus. Optical rotations were determined on a JASCO DIP-360 digital polarimeter. UV spectra in MeOH were obtained on a UV-240 spectrophotometer. IR spectra in $CHCl_3$ were determined on a IR-460 spectrometer. ^1H NMR, ^{13}C NMR, DEPT, NOESY, HMBC and nOe spectra were recorded on a Bruker AM-300 NMR spectrometer in $CDCl_3$ with TMS as an internal standard. FABMS and HRMS were recorded on a Jeol-JMS HX-110 mass spectrometer. EIMS and FDMS were recorded on a MAT-312A mass spectrometer. Purity of the compounds were confirmed by Silica gel 60 F_{254} precoated HPTLC plates (E. Merck).

Plant Material. The fresh whole plant of *Pluchea arguta* Boiss was collected from Karachi region in August 1997. The identification and authentication of plant was carried out at Botany Department, University of Karachi, where the voucher specimen is deposited.

Extraction and Isolation. The fresh whole plant material of *Pluchea arguta* (20 kg) was crushed, soaked in hexane and homogenated with an Ultra Turrax homogenizer and kept for a couple of weeks. After removal of hexane soluble part, the plant material was soaked in distilled methanol for 15 days. The methanol soluble part was concentrated *in vacuo* to gummy residue and partitioned between ethyl ether-water and ethyl acetate-water sucessively. The ethyl acetate crude extract was chromatographed over silica gel and eluted with hexane, hexane-chloroform, chloroform and chloroform-methanol. The fractions eluted with 5% and 10% MeOH/$CHCl_3$ contained **2** and **1** respectively, which were purified by repeated column chromatography.



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3′-Chloro-2′-hydroxy-3-epi-arguticinin (**1**)-yellow gum. $[\alpha]_D^{25}$ +220° (c = 0.013, $CHCl_3$). UV (MeOH) λ_{max}: 237 nm. IR ($CHCl_3$) ν_{max}: 3400 (OH), 1725 (ester, C=O), 1665 (α, β-unsaturated ketone) cm^{-1}. FABMS : *m/z* 447 $[(M+1)+2]^+$, 445 $[M+1]^+$. FDMS : *m/z* 444 (M^+, 100%), 446 (M^++2, 30%). EIMS : *m/z* 369, 371, 217, 135, 137. HRMS : *m/z* 444.1628 ($C_{22}H_{33}O_7$ Cl, calculated 444.1915). ^1H NMR ($CDCl_3$, 300 MHz) : δ 0.98 (s, 3H, H-14), 1.27 (s, 3H, H-15), 1.40 (s, 3H, H-13), 1.43 (s, 3H, H-12), 1.57 (d, *J*=6.6 Hz, 3H, H-4′), 1.60 (s, 3H, H-5′), 1.95 (s, 3H, OCO*CH*$_3$), 3.02 (d, *J*=2.9, H-5), 4.25 (q, *J*=6.0 Hz, H-3′), 5.98 (dd, *J*=8.9, 5.9 Hz, H-3), 6.89 (d, *J*=2.9 Hz, H-6). ^{13}C NMR see Table 1.

Argutenol (**2**)-Colorless crystalline solid. mp 108~109°C. $[\alpha]_D^{27}$+36.2° (c = 2.79, $CHCl_3$). UV (MeOH) λ_{max}: 207nm. IR ($CHCl_3$) ν_{max}: 3575 (OH), 1460 (C=C) cm^{-1}. FDMS : *m/z* 222. EIMS : *m/z* 222 $[M^+]$, 207, 204, 163, 149, 123, 109, 81, 59. HRMS: *m/z* 222.1980 ($C_{15}H_{26}O$, calculated 222.1984). ^1H NMR ($CDCl_3$, 300 MHz) : δ 0.90 (s, 3H, H-14), 1.26 (s, 3H, H-12), 1.27 (s, 3H, H-13), 1.65 (m, 2H, H-3), 1.70 (s, 3H, H-15), 2.00 (dd, *J*=13.1, 5.0 Hz, H-6). ^{13}C NMR see Table 1.

Table 1. ^{13}C NMR ($CDCl_3$, 75 MHz) spectral data of **1** and **2**

Carbon No.	**1** (multiplicity)	**2** (multiplicity)
1	32.4 (t)	38.1 (t)
2	22.7 (t)	18.9 (t)
3	78.0 (d)	32.7 (t)
4	80.0 (s)	125.9 (s)
5	48.8 (d)	135.0 (s)
6	141.1 (d)	44.1 (d)
7	145.0 (s)	22.5 (t)
8	198.9 (s)	25.3 (t)
9	58.0 (t)	39.4 (t)
10	39.1 (s)	34.4 (s)
11	73.9 (s)	74.5 (s)
12	28.8 (q)	27.8 (q)
13	29.9 (q)	29.7 (q)
14	18.0 (q)	19.6 (q)
15	18.6 (q)	25.9 (q)
1	174.0 (s)	
2	71.7 (s)	
3	62.7 (d)	
4	18.5 (q)	
5	23.9 (q)	
O*CO*CH$_3$	169.0 (s)	
OCO*CH*$_3$	22.7 (q)	

Results and Discussion

The IR spectrum ($CHCl_3$) of **1** showed absorption bands at 3400 (OH), 1725 (ester C=O), and 1665 (α,β-unsaturated ketone) cm^{-1}. The UV spectrum (MeOH) showed absorption at λ_{max} 237nm. The molecular mass was confirmed as 444 Daltons with the help of positive FAB and FD mass spectra. The presence of isotopic peak at *m/z* 446 (30% of M^+) revealed the presence of a chlorine moiety in the molecule. The molecular formula was established with the help of high resolution mass spectrum as $C_{22}H_{33}O_7$ Cl, corresponding to mass *m/z* 444.1628.

The olefinic proton (H-6) appeared in the ^1H NMR spectrum at δ 6.89 as a doublet (*J*=2.9 Hz). The slight upfield shift of H-6 from δ 7.10 (Arrigag-Giner *et al.*, 1983) was due to β-orientation of oxygenated function at C-4 which caused shielding effect on H-6 through spatial interactions. The H-5α appeared at δ 3.02 as a doublet with 2.9 Hz coupling constant implied a transfused decaline system (Ahmad *et al.*, 1991, Ahmad *et al.*, 1992a, Arrigag-Giner *et al.*, 1983). Out of seven methyls, six appeared in the ^1H-NMR spectrum as singlets of three protons integration each at δ 1.40,1.43 (H-12, H-13), 0.98 (H-14), 1.27 (H-15), 1.60 (H-5′), 1.95 (OCO*CH*$_3$) and the seventh as a doublet at δ 1.57 (d, *J*=6.6 Hz, H-4′). The methine attached with chlorine atom observed in the ^1H NMR spectrum as a quartet (*J*=6.6 Hz) of one proton at δ 4.25 (H-3′). The ^{13}C NMR spectrum showed three downfield quaternary signals for carbonyl carbons at δ 198.9 (C-8), 174.0 (C-1′) and 169.0 (O*CO*CH$_3$). The side chains at C-3 and C-7 were confirmed by the exact comparison of spectral data (^1H and ^{13}C NMR) with the literature (Ahmad *et al.*, 1992b). The stereochemistry of **1** was also ascertained by nOe difference and NOESY experiments. The clear NOESY interactions observed between the protons at δ 5.98 (H-3), 3.02 (H-5) and 1.27 (H-15) confirmed that these protons occupied the same side of the molecule. When the methyl signal at δ 1.27 (H-15) was irradiated in nOe difference experiment, the effects were observed at δ 6.98 (8.1%, H-6), 5.98 (4.0%, H-3) and 3.02 (3.9%, H-5) (Fig. 2).

The IR spectrum ($CHCl_3$) of **2** showed absorption bands at 3575 (OH) and 1460 (C=C) and its UV spec-

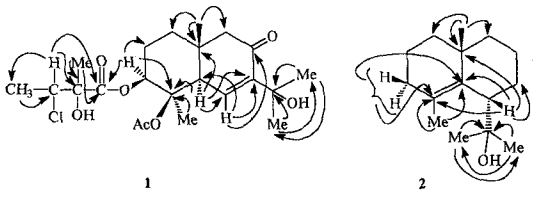

Fig. 1. HMBC interactions of 1 and 2.

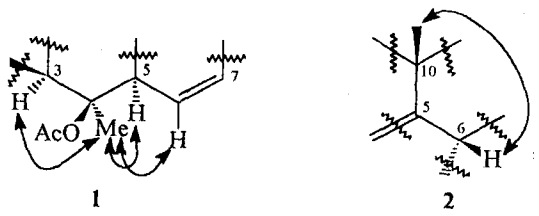

Fig. 2. Selective nOe interactions of 1 and 2.

trum (MeOH) showed only end absorption. The molecular mass of **2** was confirmed as 222 Daltons with the help of EI and FD mass spectra. The HREI mass spectrum established the molecular formula as $C_{15}H_{26}O$ which corresponded to mass *m/z* 222.1980, consistent with three degrees of unsaturation.

The four singlets, each of three protons integration in the ^1H NMR spectrum indicated the presence of four quaternary methyl signals which were also confirmed through DEPT experiment. These methyls appeared at δ 0.90 (CH_3-14), 1.70 (CH_3-15), 1.26, 1.27 (CH_3-12,13) in the ^1H NMR spectrum and at δ 19.6, 25.9, 27.8, 29.7 in the ^{13}C NMR spectrum, respectively. A signal of one proton integration in the ^1H NMR spectrum at δ 2.00 as a doublet of doublets (*J*=13.1, 5.0 Hz) was assigned to H-6 and also confirmed through HMBC experiment (Fig. 1).

The stereochemistry of H-6 was established with the help of coupling constant values (*J*=13.1, 5.0 Hz) and by the effect observed at methyl signal at δ 0.90 (9.3%) when a proton at δ 2.00 (H-6) was irradiated in the nOe difference experiment (Fig. 2). The possibility of isopropyl moiety at C-7 to afforded a eudesmane skeleton was ruled out due to the multiplicity and downfield shifting of a proton geminal to isopropyl from δ 1.37 (tt, *J*=13.0, 3.5 Hz) to δ 2.00 (dd, *J*=13.1, 5.0 Hz) when compared with dehydrocarissone (Uegaki *et al*, 1988).

Most of the ^{13}C NMR chemical shifts of **2** closely resembled the values in 4,5-*epi*-cryptomeridiol (Ahmad *et al*, 1992a), except those points where changes occurred. The protons of **1** and **2** were correlated to their respective carbons with the help of HMQC experiment and ^1H, ^{13}C NMR assignments were also confirmed through HMBC experiment (Fig. 1). With the help of above discussion, compounds **1** and **2** were characterized as 3′-chloro-2′-hydroxy-3-epi-arguticinin and argutenol respectively. Argutenol (**2**) was found to belong to gorgonane class which is very rare and derived from eudesmanes through isopropyl group migration from C-7 to C-6.

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