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Juncenolide B, a New Briarane Diterpene from the Gorgonian *Junceela juncea* of the Indian Ocean

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Chemical examination of the Indian Ocean gorgonian, *Junceella juncea* Pallas (Gorgonaceae) furnished a new non-chlorinated briarane diterpene, Juncenolide-B (1). The structure of 1 was determined as (1S, 2S, 7S, 8R, 9S, 10S, 11R, 12R, 13R)-11,20-epoxy-13-(3-methylbutanoyl)-2,9,13-triacetoxybriaran-4-en-18,7-olide on the basis of ^{1}H and ^{13}C NMR, DEPT, COSY and FABMS experiments.

Key Words: Briarane, *Junceela juncea*, Juncenolide-B, Gorgonian, Indian Ocean.

INTRODUCTION

In continuation of our search for bioactive secondary metabolites from gorgonians[1], we have investigated *Junceella juncea* Pallas (Gorgonaceae) collected from the Tuticorin coast (8°45′ E, 78°12′ N) of the Indian Ocean. Previous studies on gorgonian corals of the genus *Junceela* have resulted in the isolation of structurally novel and highly oxygenated briarane-type diterpenes, which contain a γ-lactone in a bicyclo-[8,4,0] system[2–9]. Among these metabolites some briaranes showed potential biological activities such as antitumor, anti-inflammatory, antiviral and antibacterial activities[10–13]. We report herein the isolation and characterization of a new non-chlorinated diterpene (1S, 2S, 7S, 8R, 9S, 10S, 11R, 12R, 13R)-11,20-epoxy-13-(3-methylbutanoyl)-2,9,13-triacetoxybriaran-4-en-18,7-olide named Juncenolide-B(1).

EXPERIMENTAL

Melting points were measured on a Boitus melting pont apparatus and are uncorrected. Optical rotations were taken on an Autopol polarimeter. Purification of the compound was done on Shimadzu preparative RPHPLC system with LC-8A pump, SPD-10A detector with Selectosil C8, 5 μ, 110 A (10 × 250 mm) column. IR spectra were recorded on a Perkin-Elmer BXFTIR spectrophotometer. ^{1}H, ^{13}C NMR, DEPT and COSY spectra were recorded using on AMX 400 MHz NMR instrument. TLC was carried out on silica gel-G (ACME) thin layers.

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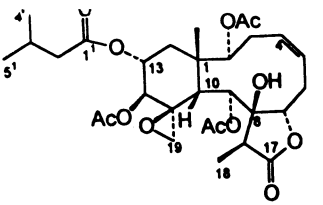
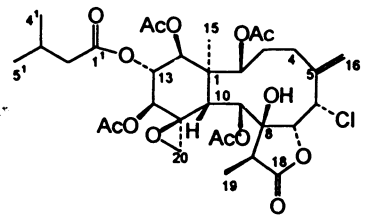
Animal Material: The gorgonian *Junceela juncea* (Pallas) was collected from Tuticorin coast (8°45′ E, 78°12′ N) of the Indian Ocean in March 1999. It was identified by Dr. P.A. Thomas, CMFRI, Trivandrum. A voucher specimen (AU2-164) was deposited in the Dept. Of Pharmaceutical Sciences, Andhra University, Visakhapatnam, Andhra Pradesh, India.

Extraction and Isolation: The collected organism was washed thoroughly with fresh water at the site and shade dried. The outer red layer of the gorgonian (dry wt. 1 kg) was carefully separated, powdered and successively extracted using n-hexane (5 L), dichloromethane (5 L) and methanol (5 L).

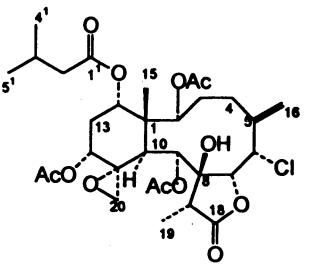
A white solid (1.2 g) separated out on concentration of the dichloromethane extract. The solid on column chromatography over silica gel (100–200 #) yielded an impure sample of the compound **1** along with Gemmacolide-B (1 g) and Juncin-H (165 mg) already reported[8]. The compound **1** was further purified by preparative RPHPLC (water : acetonitrile, 40 : 60) yielded pure sample (8 mg).



Compound 1



(+)- Gemmacolide B



Juncin H

RESULTS AND DISCUSSION

Juncenolide-B (1): It was obtained as colourless crystals, m.p. 213°C, $[\alpha]_D^{25}$ – 14.0° (c 1.0, $CHCl_3$); its m.f. of $C_{30}H_{42}O_{11}$ is derived from a molecular ion at m/z 579 $[M + H]^+$ in the FABMS. Its IR bands indicated the presence of a tertiary hydroxyl (3435 cm^{-1}), a five membered lactone (1765 cm^{-1}) and an ester carbonyl (1731 cm^{-1}).

The ^1H NMR data of compound **1** (Table-1) showed three singlets (δ 2.23, 3H; 2.02, 3H; 2.01, 3H) of methyls on O-acetyl groups, a typical methyl doublet (δ 1.26, J = 7.1 Hz), a methyl singlet (δ 1.24), a pair of doublets (δ 2.38, J = 3.4 Hz, 2H-19), a methine singlet (δ 3.65, H-10) and five oxygenated methine protons (δ 5.91, d, J = 8.4 Hz, H-2; 5.79, brs, H-9; 4.92, m, H-13; 4.60 brs, H-12; 4.44,

brs, H-7), two olefinic protons (δ 5.25, m, H 4, H 5) and a tertiary hydroxyl (δ 3.45, brs, 8-OH). The ^{13}C NMR and DEPT spectra of compound **1** showed signals for six methyl carbons, five methylene carbons and eight quaternary carbons including five ester carbons (δ 169.358, 169.769, 170.266, 171.358, 174.395).

TABLE-1
^1H AND ^{13}C NMR SPECTRAL DATA OF JUNCENOLIDE-B (1) IN $CDCl_3$, TMS AS REFERENCE AT 400 MHz; CHEMICAL SHIFT (δ), J IN Hz

Position	^{13}C	^1H	COSY
1	47.271 s	—	—
2	73.081 d*	5.91 (d, 8.4)	H-3
3	28.296 t	2.74 (m, 2H)	H-2, H-4
4	120.624 d*	5.25 (m)	H-3, H-5
5	121.148 d*	5.25 (m)	H-4, H-6
6	28.443 t	2.45 (m)	H-5, H-7
7	71.836 d	4.44 (brs)	H-6
8	81.435 s		
9	81.219 d	5.79 (brs)	H-10
10	51.445 s	3.66 (brs)	H-9
11	56.849 s		
12	73.655 d*	4.60 (brs)	H-13
13	72.746 d*	4.92 (m)	H-12, H-14
14	29.474 t	2.15 (d, 6)	H-13
15	14.219 q	1.24 (brs)	
16	35.400 d	2.94 m	H-18
17	174.395 s		
18	5.982	1.26 (d, 6.8)	H-16
19	50.769	2.38 (d, 3.4) 2.89 (d, 3.4)	
2-OAc	169.358 s*, 20.587 q*	2.23 (s)	
9-OAc	169.769 s*, 20.832 q*	2.02 (s)	
12-OAc	170.266 s*, 21.214 q*	2.01 (s)	
1^1	171.358 s*		
2^1	43.356 t	2.10 (s)	H-3′
3^1	24.990 d	2.08 (s)	H-2′, H-4′, H-5′
4^1	22.706 q	0.92 (d, 6.4)	H-3′
5^1	22.403 q	0.92 (d, 6.4)	H-3′.
8-OH		3.45 s	

Multiplicities are assigned on the basis of DEPT spectrum.
*Close δ_c values may be interchangeable.

A study of mass spectrum and ^{13}C NMR showed that there is no chlorine bearing carbon atom in compound **1**. It is observed that in most of the C6 chlorinated briarane diterpenes the chlorine bearing carbon atom resonates at about δ 53.6 and the characteristic methine proton appears at δ 4.6[7,8]. Absence of these resonances both in ^{13}C and ^{1}H NMR indicates the absence of chlorine atom at C6 in compound **1**. Further the presence of an additional methylene at δ 28.44 besides the methylene at C-3 and C-13/C-14 in the rings and the appearance of multiplet at δ 2.45 (2 H) in ^{1}H NMR confirms the absence of chlorine atom in compound **1**. Thus compound **1** shows close structural similarity with a briarane Gemmacolide-B, but differs from it by lack of chlorine atom at C-6, exocyclic methylene at C-5 and absence of a fourth O-acetyl group. The position of the double bond is fixed as follows.

In general it is noted that the exocyclic methylene carbons in briarane diterpenes appear at δ 121.1, δ 146.6 and the methylene protons resonate at δ 5.50, δ 5.80 as doublets[7,8]. In compound **1** olefinic carbons appeared at δ 120.62, δ 121.14 and their protons resonated at δ 5.25 (2H) as multiplet. This shows the absence of exocyclic methylene in compound **1**. Further the appearance of ^{13}C resonances at δ 120.62 and δ 121.14 indicates the presence of same environment for the two carbons of the double bond. This is possible only if the double bond is Δ^4. This observation is confirmed by the connectivities of H-3/H-4/H-5/H-6/H-7 using ^{1}H-^{1}H COSY spectrum.

The FABMS fragmentation showed the presence of three acetoxyls and one isovalerate group in compound **1**. The positions and stereochemistry of three O-acetyl groups could be ascertained by detailed study and comparison of ^{1}H, ^{13}C and ^{1}H-^{1}H COSY data with those of Juncin-H and Gemmacolide-B. The position of the isovalerate could be on C-13/C-14; if present on C-14, the methylene protons of C-13 appear as multiplet at δ 2.20 as observed in Juncin-H.[8] The compound **1** has showed a doublet at δ 2.15 attributed to 14-H_2 coupled to 13-H and 13-H as a multiplet at δ 4.9. The ^{1}H-^{1}H COSY connectivities of H-12/H-13/H-14 also add to this view. Based on the above data the structure of compound **1** has been determined as (1S, 2S, 7S, 8R, 9S, 10S, 11R, 12R, 13R)-11, 20-epoxy-13-(3-methylbutanoyl)-2,9,13-triacetoxybriaran-4-en-18,7-olide.

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