# Junceellolides E−G, New Briarane Diterpenes from the West Pacific Ocean Gorgonian *Junceella fragilis*

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Three new diterpenes, junceellolides E−G (**1**−**3**), along with an unnamed known diterpene **4**, possessing the briarane carbon skeleton, have been isolated from the gorgonian *Junceella fragilis* collected in Taiwanese tropical waters. The structures of the new metabolites **1**−**3** were elucidated by extensive spectral analyses. The six-membered rings in junceellolides E and F (**1** and **2**) were found to exist in boat conformations. The structure, including the relative configuration of junceellolide E (**1**) was further confirmed by a single-crystal X-ray analysis.

As part of our continuing investigations on the chemical constituents of the Taiwanese soft corals,[1−8] the gorgonian *Junceella fragilis* Ridley (phylum Cnidaria, class Anthozoa, order Gorgonacea, family Ellisellidae), which was a major inhabitant in Taiwanese tropical waters, has been the subject of an investigation. Previous studies on gorgonian corals of the genus *Junceella* have resulted in the isolation of 27 structurally novel and highly oxygenated briarane-type diterpenes, which contain a γ-lactone in a bicyclo-[8,4,0] system,[9−16] including junceellolides A−D.[11] Among these metabolites, some briaranes showed potential biological activities such as antiinflammatory and antiviral activity.[11] This work has led to the discovery of three new briaranes, junceellolides E−G (**1**−**3**) along with an unnamed known diterpene **4**[17] from *J. fragilis.* We report herein the isolation and structure determination of these metabolites. The structures of the metabolites **1**−**4** were elucidated by a series of spectral analyses and by comparison with the spectral and physical data from other known compounds. The structure, including the relative configuration of junceellolide E (**1**), was further confirmed by a single-crystal X-ray diffraction analysis.

## Results and Discussion

The gorgonian *J. fragilis* was frozen immediately after collection and subsequently freeze-dried. The freeze-dried organism was extracted with EtOAc to afford a crude extract. The crude extract was resolved by extensive column chromatography on Si gel and afforded three new diterpenes, junceellolides E−G (**1**−**3**), and the known diterpene **4**, (see Experimental Section).

Junceellolide E (**1**) crystallized as colorless needles during slow evaporation of a Si gel chromatography fraction (hexanes−EtOAc, 4:1). Its HRFABMS established the molecular formula $C_{27}H_{38}O_9$. Thus, nine degrees of unsaturation were determined for **1**. The IR spectrum showed bands at 3456, 1766, and 1730 $cm^{-1}$, consistent with the
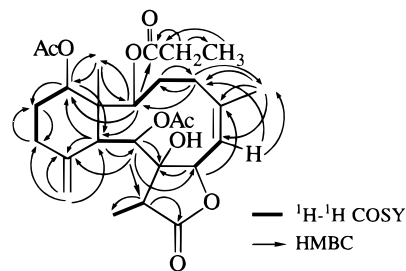


**Figure 1.** $^1H-^1H$ COSY and HMBC correlations for **1**.

presence of hydroxyl, γ-lactone, and ester carbonyl groups in the structure of **1**. The FABMS of **1** exhibited peaks at $m/z$ 507 $[M + H]^+$, 447 $[M + H - HOAc]^+$, 433 $[M + H - C_2H_5CO_2H]^+$, 373 $[M + H - C_2H_5CO_2H - HOAc]^+$, 355 $[M + H - C_2H_5CO_2H - HOAc - H_2O]^+$, 313 $[M + H - C_2H_5CO_2H - 2HOAc]^+$, and 295 $[M + H - C_2H_5CO_2H - 2HOAc - H_2O]^+$, suggesting the presence of a hydroxyl, a propionyloxy, and two acetoxyl groups in **1**. From the $^{13}C$ spectral data of **1** (Table 1), a trisubstituted olefin and an exocyclic carbon−carbon double bond were deduced from the signals of four carbons resonating at δ 151.0 (s), 145.2 (s), 120.4 (d), and 113.1 (t). Furthermore, in the $^{13}C$ NMR spectrum of **1**, four carbonyl resonances appeared at δ 176.1 (s), 173.7 (s), 170.3 (s), and 169.5 (s), confirming the presence of a γ-lactone and three other ester groups in the structure of **1**. In the $^1H$ NMR spectrum of **1** (Table 1), a propionyloxy (δ 2.26, 2H, q, *J* = 7.2 Hz; 1.09, 3H, t, *J* = 7.2 Hz) and two acetoxyl (δ 2.20, 3H, s; 1.90, 3H, s) groups were observed. Based on the above data, metabolite **1** was found to be a tricyclic compound. The structure and all of the $^1H$ and $^{13}C$ chemical shifts of **1** were determined by the assistance of 2D NMR ($^1H-^1H$ COSY, HMQC, and HMBC). From an $^1H-^1H$ COSY experiment of **1** (Figure 1), it was possible to establish the separate spin systems that map out the proton sequences from H-2 to $H_2$-4, H-6 to H-7, H-9 to H-10, $H_2$-12 to H-14, and H-17 to $H_3$-18. From the data of an HMBC experiment of **1** (Figure 1 and Table 2), the molecular framework of **1** could be further established. These data also revealed that the carbon signal at δ 173.7 was correlated with the signal of the methylene protons of the propionate at δ 2.26 in the HMBC spectrum of **1** and was consequently assigned as the carbon atom of

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**Table 1.** ¹H and ¹³C NMR Chemical Shifts for Junceellolides E−G (**1**−**3**)

| | 1 | | 2 | | 3 | |
|---|---|---|---|---|---|---|
| position | ¹H[a] | ¹³C[b] | ¹H[a] | ¹³C[b] | ¹H[c] | ¹³C[d] |
| 1 | | 46.9 (s)[f] | | 46.9 (s) | | 52.7 (s) |
| 2 | 4.87 br s | 74.0 (d) | 4.75 d (4.8) | 74.4 (d) | 3.40 t (5.0) | 75.8 (d) |
| 3/3′ | 2.34 m | 31.2 (t) | 2.48 m | 32.1 (t) | 1.95 m | 34.8 (t) |
| | 1.78 m | | 1.64 m | | 1.70 m | |
| 4/4′ | 2.62 br d (14.0)[e] | 29.1 (t) | 2.52 br d (14.0) | 28.8 (t) | 2.65 m | 29.1 (t) |
| | 2.15 m | | 2.06 m | | 2.13 m | |
| 5 | | 145.2 (s) | | 143.8 (s) | | 145.3 (s) |
| 6 | 5.65 d (9.6) | 120.4 (d) | 5.62 d (10.0) | 120.8 (d) | 5.41 d (9.5) | 119.3 (d) |
| 7 | 5.28 d (9.6) | 78.0 (d) | 5.15 d (10.0) | 77.8 (d) | 5.32 d (9.5) | 77.7 (d) |
| 8 | | 83.1 (s) | | 80.2 (s) | | 80.9 (s) |
| 9 | 5.31 d (6.0) | 71.3 (d) | 5.63 d (5.6) | 67.6 (d) | 5.19 d (6.0) | 68.5 (d) |
| 10 | 3.44 d (6.0) | 41.8 (d) | 2.41 d (5.6) | 39.7 (d) | 2.00 d (6.0) | 49.9 (d) |
| 11 | | 151.0 (s) | | 62.4 (s) | | 89.3 (s) |
| 12/12′ | 2.19 m | 26.3 (t) | 2.30 m | 23.7 (t) | 2.07 m | 29.5 (t) |
| 13/13′ | 2.02 m | 26.8 (t) | 2.12 m | 24.3 (t) | 2.05 m | 27.6 (t) |
| | 1.80 m | | 1.78 dt (15.2; 10.0) | | 1.87 m | |
| 14 | 4.63 br s | 74.4 (d) | 4.80 d (5.2) | 73.5 (d) | 4.45 d (4.5) | 82.0 (d) |
| 15 | 1.10 s | 15.6 (q) | 1.10 s | 14.7 (q) | 0.91 s | 14.0 (q) |
| 16 | 2.06 s | 27.0 (q) | 2.04 s | 28.2 (q) | 1.92 s | 26.6 (q) |
| 17 | 2.45 q (7.2) | 42.5 (d) | 2.35 q (7.2) | 42.3 (d) | 2.42 q (7.0) | 42.1 (d) |
| 18 | 1.11 d (7.2) | 6.5 (q) | 1.15 d (7.2) | 6.6 (q) | 1.16 d (7.0) | 6.6 (q) |
| 19 | | 176.1 (s) | | 176.5 (s) | | 176.3 (s) |
| 20 | 5.04 s (Hₐ) | 113.1 (t) | 2.97 d (4.4) (Hₐ) | 59.1 (t) | 1.42 s | 23.2 (q) |
| | 4.92 s (Hᵦ) | | 2.85 d (4.4) (Hᵦ) | | | |
| OH-8 | n.o.[g] | | 4.92 s | | n.o.[g] | |
| acetate methyls | 1.90 s | 21.2 (q) | 1.97 s | 21.0 (q) | 2.18 s | 21.4 (q) |
| | 2.20 s | 21.7 (q) | 2.23 s | 21.7 (q) | | |
| acetate carbonyls | | 169.5 (s) | | 169.5 (s) | | 169.4 (s) |
| | | 170.3 (s) | | 169.9 (s) | | |
| propionate | CH₃ 1.09 t (7.2) | 8.9 (q) | CH₃ 1.11 t (7.2) | 8.9 (q) | | |
| | CH₂ 2.26 q (7.2) | 27.6 (t) | CH₂ 2.27 q (7.2) | 27.6 (t) | | |
| | | 173.7 (s) | | 173.9 (s) | | |

[a] Spectra recorded at 400 MHz in CDCl₃ at 25 °C. [b] 100 MHz in CDCl₃ at 25 °C. [c] 500 MHz in CDCl₃ at 25 °C. [d] 100 MHz in CDCl₃ at 25 °C. [e] *J* values (in Hz) in parentheses. [f] Multiplicity deduced by DEPT and indicated by usual symbols. The values are in ppm downfield from TMS. [g] n.o. = not observed.

**Table 2.** HMBC Correlations for Diterpenes **1** and **3**

| position | 1 | 3 |
|---|---|---|
| 1 | n.o.[a] | H-2, H-10, H₂-13, H₃-15 |
| 2 | H₂-4, H₃-15 | H₂-3, H-14, H₃-15 |
| 3 | H₂-4 | n.o.[a] |
| 4 | H₂-3, H-6, H₃-16 | H-2, H₂-3, H-6, H₃-16 |
| 5 | H-7, H₃-16 | H₂-3, H-7, H₃-16 |
| 6 | H₃-16 | H-7, H₃-16 |
| 7 | H-9 | H-9 |
| 8 | H-7, H-9 | H-9, H-10, H-17, H₃-18 |
| 9 | H-10 | H-10 |
| 10 | H-2, H-14, H₂-20 | H-2, H-9, H-14, H₃-15, H₃-20 |
| 11 | H-9, H-10, H₂-20 | H-9, H-10, H-14, H₃-20 |
| 12 | H₂-13, H₂-20 | H-10, H₂-13, H-14, H₃-20 |
| 13 | H₂-12, H-14 | H₂-12, H-14 |
| 14 | H-2, H-10, H₃-15 | H₂-13, H₃-15 |
| 15 | H-2, H-14 | H-2 |
| 16 | H₂-4, H-6 | n.o.[a] |
| 17 | H-9 | H-9, H₃-18 |
| 18 | H-17 | H-17 |
| 19 | H-17 | H-17, H₃-18 |
| 20 | n.o.[a] | n.o.[a] |
| 2-O*C*OEt | H-2, H₂-22 | |
| 9-O*C*OMe | H-9 | H-9 |
| 14-O*C*OMe | H-14 | |

[a] n.o. = not observed.

the propionate carbonyl group. The propionate positioned at C-2 was confirmed from the connectivity between H-2 (δ 4.87) and the carbonyl carbon (δ 173.7) of the propionyloxyl group. Furthermore, the HMBC correlations revealed that two acetoxyl groups are attached to the C-9 and C-14 positions, respectively. Thus, the remaining hydroxyl group had to be positioned at C-8, an oxygen-bearing quaternary carbon resonating at δ 83.1 ppm.
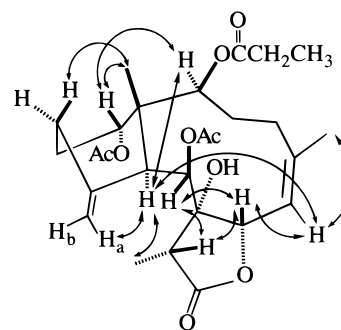


**Figure 2.** Selective NOE correlations of **1**.

The relative stereochemistry of **1** was deduced from a NOESY experiment (Figure 2). The NOE correlations of H-10 with H-2 and H₃-18 indicated that these protons are situated on the same face and were assigned as the α protons because the C-15 methyl is β oriented and H₃-15 did not show correlation with H-10. H-14 was found to exhibit NOE responses with H-2 and H₃-15, but not with H-10, revealing the β orientation of this proton. It was found that H-7, H-9, and H-17 showed NOE correlations with each other. Consideration of molecular models revealed that H-9 is reasonably close to H-7 and H-17 when H-7 and H-17 are β oriented, and H-9 is placed on the α face. The NOE correlation between H-10 and H-6 suggested that the Δ⁵ double bond in the 10-membered ring is oriented in such a way that the H-6 is on the same side as H-10. The large coupling constant observed (9.6 Hz) reveals the antiparallel arrangement of H-6 and H-7 and the β orientation of H-7. Furthermore, a proton of the C-20

**Table 3.** Atomic Coordinates and $B_{eq}$ of Diterpene **1**

| atom | $x$ | $y$ | $z$ | $B_{eq}{}^a$ |
|---|---|---|---|---|
| C (1) | 0.5919(3) | 0.0436(5) | 0.2445(1) | 3.76(5) |
| C (2) | 0.6341(3) | −0.0833(5) | 0.2945(1) | 4.56(6) |
| C (3) | 0.6015(3) | −0.2165(5) | 0.2530(1) | 5.19(7) |
| C (4) | 0.7394(4) | −0.3211(5) | 0.2776(1) | 6.34(7) |
| C (5) | 0.9081(3) | −0.2766(5) | 0.2715(1) | 5.60(6) |
| C (6) | 0.9493(3) | −0.2384(5) | 0.2082(1) | 4.39(5) |
| C (7) | 0.8367(2) | −0.2356(5) | 0.1309(1) | 3.48(5) |
| C (8) | 0.8111(2) | −0.0985(5) | 0.0900(1) | 2.75(4) |
| C (9) | 0.6792(2) | −0.0052(5) | 0.1093(1) | 2.87(4) |
| C (10) | 0.7226(2) | 0.0525(5) | 0.1922(1) | 3.07(4) |
| C (11) | 0.7772(3) | 0.1974(5) | 0.1861(1) | 4.44(5) |
| C (12) | 0.6416(3) | 0.2981(5) | 0.1792(1) | 5.93(7) |
| C (13) | 0.5855(4) | 0.2993(5) | 0.2546(2) | 6.65(8) |
| C (14) | 0.6206(3) | 0.1676(5) | 0.2965(1) | 4.88(5) |
| C (15) | 0.4076(3) | 0.0446(5) | 0.2059(1) | 5.26(6) |
| C (16) | 1.0363(4) | −0.2734(5) | 0.3454(1) | 9.1(1) |
| C (17) | 0.7679(2) | −0.1456(5) | 0.0073(1) | 3.05(4) |
| C (18) | 0.7819(2) | −0.0467(5) | −0.0550(1) | 3.89(5) |
| C (19) | 0.8771(2) | −0.2668(5) | 0.0101(1) | 3.61(5) |
| C (20) | 0.9302(3) | 0.2315(5) | 0.1900(1) | 6.34(7) |
| C (21) | 0.6075(4) | −0.0895(6) | 0.4235(2) | 8.37(9) |
| C (22) | 0.4835(5) | −0.0640(7) | 0.4732(2) | 11.6(1) |
| C (23) | 0.5661(6) | −0.0360(9) | 0.5521(2) | 22.1(3) |
| C (24) | 0.4113(2) | −0.0344(5) | 0.0293(1) | 3.85(5) |
| C (25) | 0.2680(3) | −0.1280(5) | 0.0139(1) | 5.24(6) |
| C (26) | 0.8299(5) | 0.2026(6) | 0.4093(2) | 9.7(1) |
| C (27) | 1.0081(5) | 0.1779(8) | 0.4432(2) | 16.1(2) |
| O (1) | 0.5337(2) | −0.0771(5) | 0.35102(8) | 5.74(5) |
| O (2) | 0.7494(3) | −0.1108(6) | 0.4450(1) | 12.16(9) |
| O (3) | 0.9167(2) | −0.3165(5) | 0.08117(8) | 3.83(3) |
| O (4) | 0.9668(1) | −0.0349(4) | 0.10762(7) | 3.18(3) |
| O (5) | 0.9261(2) | −0.3161(5) | −0.04080(8) | 4.69(4) |
| O (6) | 0.5267(1) | −0.0788(4) | 0.08930(7) | 3.21(3) |
| O (7) | 0.4268(2) | 0.0646(5) | −0.00618(9) | 5.38(4) |
| O (8) | 0.7911(2) | 0.1609(5) | 0.33777(8) | 5.63(4) |
| O (9) | 0.7310(3) | 0.2455(6) | 0.4411(1) | 15.1(1) |

$^a$ $B_{eq}$ is the mean of the principal axes of the thermal ellipsoid.
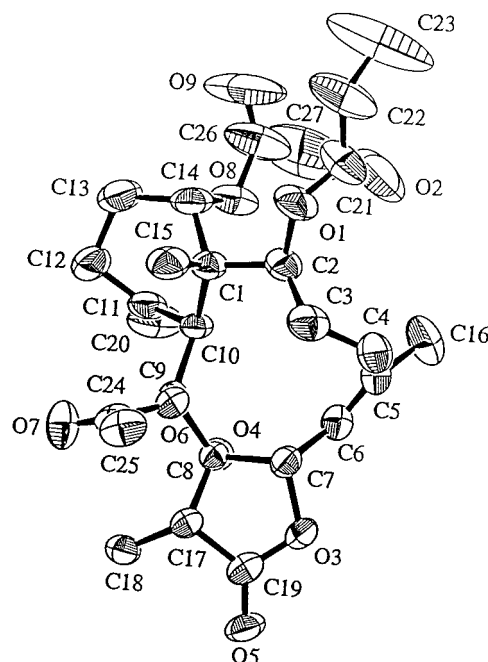


**Figure 3.** A computer-generated ORTEP plot of **1** showing relative configuration. Hydrogen atoms have been omitted for clarity.



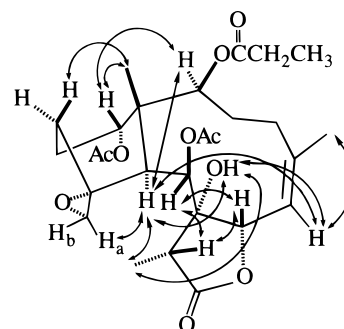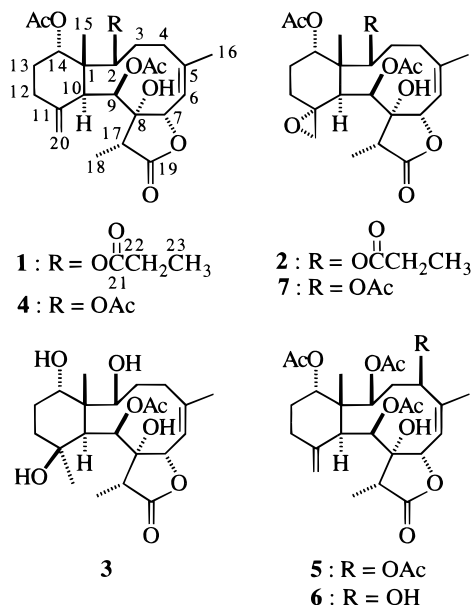**Figure 4.** Selective NOE correlations of **2**.

methylene ($\delta$ 5.04, s, $H_a$-20) was found to exhibit a strong NOE response with H-10, but not with $H_3$-18, and $H_3$-15 showed a NOE correlation with H-12$\beta$, indicating the cyclohexane ring of **1** should be presented as a boat rather than a chair conformation for metabolite **1**, based on the consideration of a 3D model of **1**. A single-crystal X-ray structure analysis was carried out in order to confirm the molecular structure of **1**. The final atomic parameters of the non-hydrogen atoms are listed in Table 3. The X-ray structure (Figure 3) further confirms the boat conformation of the cyclohexane ring and demonstrates the location of a hydroxyl group in the $\alpha$ orientation of C-8. The structure, including the relative stereochemistry of diterpene **1**, was thus elucidated unambiguously and found to be closely related to two known diterpenes, junceellolide D (**5**)[11] and (−)-4-deacetyljunceellolide D (**6**).[16] It is worthwhile to note that this is the first observation that the cyclohexane unit of a briarane-type diterpene is found in a boat conformation.

The new diterpene junceellolide F (**2**) had the molecular formula $C_{27}H_{38}O_{10}$ as determined by HRFABMS. Its IR spectrum exhibited a broad OH stretch at 3436 cm$^{-1}$, a $\gamma$-lactone carbonyl at 1762 cm$^{-1}$, and ester carbonyls at 1730 cm$^{-1}$. The FABMS of **2** exhibited peaks at $m/z$ 523 [M + H]$^+$, 507 [M + H − O]$^+$, 463 [M + H − HOAc]$^+$, 449 [M + H − $C_2H_5CO_2H$]$^+$, 389 [M + H − $C_2H_5CO_2H$ − HOAc]$^+$, 371 [M + H − $C_2H_5CO_2H$ − HOAc − $H_2O$]$^+$, 329 [M + H − $C_2H_5CO_2H$ − 2HOAc]$^+$, and 311 [M + H − $C_2H_5CO_2H$ − 2HOAc − $H_2O$]$^+$, indicating the presence of a hydroxyl, a propionyloxyl, and two acetoxyl groups in **2**. It was found that the spectral data (IR, $^1$H, and $^{13}$C NMR) of **2** were very similar to those of **1**. However, the $^1$H and

$^{13}$C NMR spectral data revealed that the signals corresponding to the exocyclic carbon−carbon double bond in **1** ($\delta_H$ 5.04, 1H, s, $H_a$-20; 4.92, 1H, s, $H_b$-20; $\delta_C$ 151.0, s, C-11; 113.1, t, C-20) were not present and were replaced by an epoxy group in **2** ($\delta_H$ 2.97, 1H, d, $J$ = 4.4 Hz, $H_a$-20; 2.85, 1H, d, $J$ = 4.4 Hz, $H_b$-20; $\delta_C$ 62.4, s, C-11; 59.1, t, C-20) (Table 1). In the HMBC experiment on **2**, the carbon signal at $\delta$ 173.9 was correlated with the signal of the methylene protons of the propionate at $\delta$ 2.27, and so was assigned as the carbon atom of the propionate carbonyl group. The propionate was positioned at C-2 because of an HMBC correlation between H-2 ($\delta$ 4.75) and the carbonyl carbon ($\delta$ 173.9) of the propionate. The positions of the other two acetoxyl groups at C-9 and C-14 were also confirmed by the correlations between the methine protons at $\delta$ 5.63 (H-9) and 4.80 (H-14) with the ester carbonyls at $\delta$ 169.5 (s) and 169.9 (s), respectively, in the HMBC spectrum of **2**. The relative stereochemistry of **2** was determined by a NOESY experiment (Figure 4), and by comparison of the related spectral data ($^1$H and $^{13}$C NMR) with those of **1** and a known metabolite (−)-11$\alpha$,20$\alpha$-epoxy-4-deacetoxy-junceellolide D (**7**).[16] In the NOESY experiment of **2**, the hydroxyl proton ($\delta$ 4.92, s) at C-8 showed NOE correspondences with H-6, H-10, and $H_3$-18, and confirmed the $\alpha$-orientation of this hydroxyl group. Furthermore, the NOE correlations of $H_a$-20 with H-10, and $H_3$-15 with H-12$\beta$, indicated that the cyclohexane ring of **2** also

possesses a boat conformation, similar to that of **1**. By the above observations, junceellolide F (**2**) was found to be the $11\alpha,20\alpha$-epoxy derivative of diterpene **1**. Compared to previous analyses of briarane-type diterpenes, the six-membered ring boat conformations in junceellolides E and F (**1** and **2**) are unusual.



**1** : R = OCCH$_2$CH$_3$
**4** : R = OAc

**2** : R = OCCH$_2$CH$_3$
**7** : R = OAc

**3**

**5** : R = OAc
**6** : R = OH

Junceellolide G (**3**) was isolated as a white powder, and a molecular formula of $C_{22}H_{34}O_8$ was established by HR-FABMS. Accordingly, six degrees of unsaturation were determined for **3**. The IR absorptions of **3** showed the presence of hydroxyl ($\nu_{max}$ 3440 cm$^{-1}$), $\gamma$-lactone ($\nu_{max}$ 1760 cm$^{-1}$), and ester carbonyl ($\nu_{max}$ 1728 cm$^{-1}$) groups. The FABMS of **3** exhibited peaks at $m/z$ 427 [M + H]$^+$, 409 [M + H − H$_2$O]$^+$, 391 [M + H − 2H$_2$O]$^+$, 349 [M + H − HOAc − H$_2$O]$^+$, 331 [M + H − HOAc − 2H$_2$O]$^+$, 313 [M + H − HOAc − 3H$_2$O]$^+$, and 295 [M + H − HOAc − 4H$_2$O]$^+$, indicating the presence of an acetoxyl and four hydroxyl groups. From the $^{13}$C NMR spectral data of **3** (Table 1), a trisubstituted olefin was deduced from the signals for two carbons at $\delta$ 145.3 (s) and 119.3 (d). Furthermore, in the $^{13}$C NMR spectrum of **3**, two carbonyl resonances present at $\delta$ 176.3 (s) and 169.4 (s) confirmed the presence of a $\gamma$-lactone and an additional ester in **3**. In the $^1$H NMR spectrum of **3** (Table 1), an acetate methyl ($\delta$ 2.18, 3H, s) was observed. On the basis of overall unsaturation, compound **3** was concluded to be a diterpene molecule that possesses three rings. The gross structure of **3** and all of the $^1$H and $^{13}$C chemical shifts associated with the molecule were determined by the combination of 2D NMR spectral analyses. From the $^1$H−$^1$H COSY spectrum of **3**, it was possible to establish the proton sequences from H-2 to H$_2$-4, H-6 to H-7, H-9 to H-10, H$_2$-12 to H-14, and H-17 to H$_3$-18. These data, together with the $^1$H−$^{13}$C long-range correlations observed in the HMBC experiment on **3** (Table 2), also established the briarane-type molecular framework for **3**. The position of the acetoxyl group at C-9 in **3** was confirmed by the correlation between the methine proton at $\delta$ 5.19 (H-9) with the ester carbonyl at $\delta$ 169.4 (s) in the HMBC spectrum. Also, the remaining hydroxyl groups should be attached at C-2, C-8, C-11, and C-14 by detailed 2D NMR spectral analyses, including the $^1$H−$^1$H COSY, HMQC, and HMBC experiments. The relative stereochemistry of **3** was elucidated by a NOESY experiment (Figure 5). In the NOESY experiment of **3**, the methyl protons
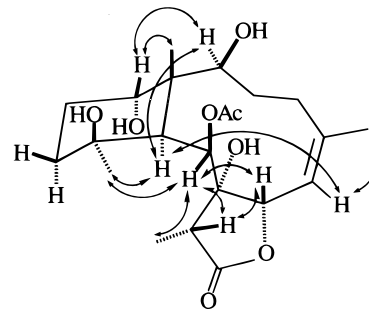


**Figure 5.** Selective NOE correlations of **3**.

at C-20 showed NOE correspondences with H-9 and H-10. H$_3$-15 was not correlated with H-12$\beta$, indicating that the cyclohexane ring of **3** possesses a chair conformation. Thus, the structure of junceellolide G (**3**) was confirmed unambiguously. It is noted that **3** is the only briarane-type diterpene known to possess hydroxyl groups at all four of the C-2, C-8, C-11, and C-14 positions.

Compound **4** was identified as a known diterpene, which had been isolated from an Indian Ocean gorgonian, *Gorgonella umbraculum.* Its physical (mp and optical rotation) and spectral (IR, MS, $^1$H, and $^{13}$C NMR) data are in full agreement with those reported previously.[17] Although many briarane-based diterpenes have been shown to exhibit interesting biological activities, diterpenes **1**−**4** were found not to be cytotoxic toward a limited panel of tumor cells (P-388, A549, and HT-29).

## Experimental Section

**General Experimental Procedures.** Melting points were determined using a Fisher-Johns melting point apparatus and were uncorrected. Optical rotations were measured on a JASCO DIP-1000 digital polarimeter. IR spectra were recorded on a Hitachi I-2001 infrared spectrophotometer. The NMR spectra were recorded on a Bruker AMX-400 FT-NMR at 400 MHz for $^1$H and 100 MHz for $^{13}$C or on a Varian Unity INOVA 500 FT-NMR at 500 MHz for $^1$H and 125 MHz for $^{13}$C, respectively, in CDCl$_3$ using TMS as an internal standard. FABMS spectra were obtained with a VG Quattro GC/MS spectrometer. HRFABMS spectra were recorded on a JMX-HX 110 mass spectrometer. Si gel (Merck, 230−400 mesh) was used for column chromatography. Precoated Si gel plates (Merck, Si gel 60 F$_{254}$, 0.2 mm) were used for analytical TLC.

**Animal Material.** The gorgonian *J. fragilis* was collected by hand using scuba at Green Island, located on the southeast coast of Taiwan, in February 1999, at depths of 15−18 m, and was stored in a freezer until extraction. A voucher specimen was deposited in the Department of Marine Resources, National Sun Yat-Sen University (specimen no. GISC-101).

**Extraction and Isolation.** The gorgonian (1.2 kg fresh wt) was collected and freeze-dried. The freeze-dried material (0.8 kg) was minced and extracted exhaustively with EtOAc (5 L × 6). The organic extract was evaporated to give a residue (6.80 g) which was separated by Si gel column chromatography using hexanes and hexanes−EtOAc mixtures of increasing polarity. Diterpene **1** was eluted with hexanes−EtOAc (4:1), **2** with hexanes−EtOAc (7:2), **4** with hexanes−EtOAc (3:1), and **3** with hexanes−EtOAc (1:1).

**Junceellolide E (1):** colorless prisms (12.1 mg); mp 195−196 °C; [α]$^{26}_D$ −111° (c 0.6, CHCl$_3$); IR (KBr) $\nu_{max}$ 3456, 1766, 1730, and 1234 cm$^{-1}$; $^1$H and $^{13}$C NMR data, see Table 1; FABMS $m/z$ 507 (0.6, [M + H]$^+$), 447 (1), 433 (7), 373 (2), 355 (1), 313 (6), and 295 (5); HRFABMS $m/z$ 507.2577 (calcd for $C_{27}H_{39}O_9$, 507.2583).

**Junceellolide F (2):** white powder (12.5 mg); mp 103−104 °C; [α]$^{26}_D$ −127° (c 0.6, CHCl$_3$); IR (KBr) $\nu_{max}$ 3436, 1762, 1730, and 1220 cm$^{-1}$; $^1$H and $^{13}$C NMR data, see Table 1; FABMS $m/z$ 523 (2, [M + H]$^+$), 507 (0.4), 463 (0.6), 449 (2),

389 (2), 371 (0.8), 329 (3) and 311 (3); HRFABMS *m*/*z* 523.2529 (calcd for $C_{27}H_{39}O_{10}$, 523.2532).

**Junceellolide G (3):** white powder (4.2 mg); mp 128–130 °C; $[\alpha]^{26}_D$ −71° (*c* 0.2, $CHCl_3$); IR (KBr) $\nu_{max}$ 3440, 1760, 1728, and 1224 cm$^{-1}$; $^1H$ and $^{13}C$ NMR data, see Table 1; FABMS *m*/*z* 427 (2, [M + H]$^+$), 409 (0.7), 391 (13), 349 (0.7), 331 (1), 313 (2), and 295 (0.7); HRFABMS *m*/*z* 427.2328 (calcd for $C_{22}H_{35}O_8$, 427.2322).

**Diterpene 4:** white powder (33.5 mg); mp 218–220 °C (lit.[17] 217–219 °C); $[\alpha]^{25}_D$ −39° (*c* 0.8, $CHCl_3$) (lit.[17] $[\alpha]^{30}_D$ −37° (*c* 0.51); spectral data (IR, MS, $^1H$ and $^{13}C$ NMR) of **4** in full agreement with those of the reported previously.[17]

**Single-Crystal X-ray Crystallography of 1.**[18] Suitable colorless prisms of **1** were obtained from a solution in EtOH. The crystal (0.50 × 0.58 × 0.78 mm) belongs to the monoclinic system, space group $P2_1$ with *a* = 8.374(3) Å, *b* = 9.974(2) Å, *c* = 18.132(2) Å, *V* = 1474.7(7) Å$^3$, *Z* = 2, $D_{calcd}$ = 1.141 g/cm$^3$, $\lambda$(Mo Kα) = 0.71069 Å. Intensity data were measured on a Rigaku AFC7S diffractometer up to 2θ of 55.0°. Of the 3800 reflections that were collected, 3564 were unique ($R_{int}$ = 0.015). The structure was solved by dirtect method and refined by a full-matrix least-squares procedure. The non-hydrogen atoms were given anisotropic thermal parameters. The refinement converged to a final *R* = 0.042, $R_w$ = 0.037 for 2456 observed reflections [*I* > 3.00σ(*I*)] and 325 variable parameters.

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(18) Atomic coordinates for this structure have been deposited with the Cambridge Crystallographic Data Centre and are available on request to the Director, Cambridge Crystallographic Data Centre, 12 Union Road, Cambridge CB2 1EZ, UK.