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CHEMICAL CONSTITUENTS OF THE NUDIBRANCH *CHROMODORIS MARISLAE*

Jill E. Hochlowski and D. John Faulkner

Scripps Institution of Oceanography (A-012)
La Jolla, California 92093, U.S.A.

Abstract: The major metabolite of *Chromodoris marislae*, marislin (1a) was identified from spectral data and converted into the sponge metabolite pleraplysillin-2 (1b).

Nudibranchs are brightly-colored shell-less mollusks. Since they lack physical defences against predation, it has been assumed that the nudibranchs, like other opisthobranch mollusks,[1] employ a chemical defence mechanism.[2] The dorid nudibranch *Chromodoris marislae* Bertsch is colored white with bright orange spots.[3] The animals were collected by hand (-8 m) at various locations in the western Gulf of California.

The dichloromethane-soluble material (4.0 mg/animal) from a methanolic extract of *C. marislae* was chromatographed on Florisil to obtain marislin (1a, 2.0 mg/animal) as the major metabolite. More polar fractions were rechromatographed by LC on μ-porasil to obtain four minor metabolites 2a,b and 3a,b, isolated as two inseparable pairs of isomeric esters.

Marislin (1a) was obtained as an optically-inactive oil having the molecular formula $C_{20}H_{24}O_4$ (328.1690). The IR spectrum contained an ester band at 1735 cm^{-1} and a strong olefinic band at 1650 cm^{-1}. The ^1H NMR spectrum (Table 1) contained signals that could be assigned[4] to the C_{15} acid portion of pleraplysillin-2 (1b).[5] By analogy to model compounds,[6] fifteen signals from the ^{13}C NMR spectrum[7] of marislin (1a) were assigned to the acid portion of the molecule. The remaining five carbon signals at δ 96.3 (d), 105.2 (t), 105.6 (d), 152.7 (d) and 165.1 (s) were attributed to an acetal carbon, two carbons of an exocyclic methylene group and two carbons of an enol ether moiety. The ^1H NMR signals for the C_5 acetal portion of marislin (1a) were

assigned as the result of careful decoupling experiments. The band at 258 nm (ε 11,650) in the UV spectrum was attributed to the diene in the C_5 acetal portion of the molecule.

The structures of marislin (1a) and pleraplysillin-2 (1b) are formally related by a [3,3] sigmatropic rearrangement. This rearrangement occurred very slowly during routine handling but treatment of marislin (1a) with boron trifluoride etherate in anhydrous ether caused complete rearrangement to pleraplysillin-2 (1b). Pyrolysis of marislin at 290°C for 4 min. gave a 1:1:1 mixture of marislin (1a), pleraplysillin-2 (1b) and the acid (1, R = H). The 1:1 mixture of 1a and 1b could not be separated but the ^{1}H NMR spectrum served as an excellent model for those of the minor metabolite mixtures.

The mixture[8] of ketones (2a,b, 0.08 mg/animal) had the molecular formula $C_{20}H_{28}O_4$. An IR band at 1725 cm^{-1} was attributed to both ester and ketone groups. The ^{1}H NMR spectrum (Table 1) contained small (0.5 H) signals due to the 1:1 mixture of two C_5 units and larger signals assigned to a common C_{15} acid portion. The signal at δ 0.89 (d, 6 H, J = 6 Hz) coupled to a signal at 2.15 (m, 1 H) required a terminal isopropyl group, while the signal at 3.02 (s, 2 H) was assigned to the C-8 methylene protons. We therefore proposed the structure 2 for the C_{15} acid portion of the ketone.

The mixture of lactones (3a,b, 0.06 mg/animal) had the molecular formula $C_{21}H_{26}O_6$. The IR bands at 1790 and 1720 cm^{-1} suggested the presence of the α,β-unsaturated γ-lactone and α,β-unsaturated ester groups. The ^{1}H NMR spectrum (Table 1) contained a methoxy signal at δ 3.18 (s, 3 H), a signal at 6.68 (bs, 1 H) due to the β-proton on an α,β-unsaturated lactone, coupled to a methyl signal at 1.93 (bs, 3 H), and an AB quartet at 2.54 (d, 1 H, J = 17 Hz) and 2.61 (d, 1 H, J = 17 Hz) due to the non-equivalent methylene protons at C-8. We proposed structure 3 for the C_{15} portion of the lactone. The γ-methoxy-α,β-unsaturated γ-lactone functionality may be formed by air-oxidation of the corresponding furan in methanolic solution. Thus, the mixture of lactones 3a and 3b was probably an artifact of isolation.

Chromodoris species are known to eat sponges. The close structural relationship between marislin (1a) and pleraplysillin-2 (1b), a metabolite of the Mediterranean sponge *Pleraplysilla spinifera*, is therefore not surprising. It is remarkable, however, that the nudibranch should concentrate essentially only one metabolite, presumably a metabolite of an unidentified sponge.[9]

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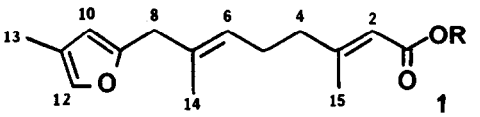

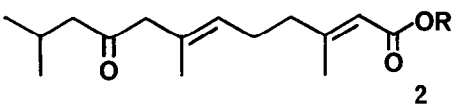

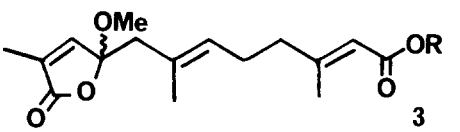

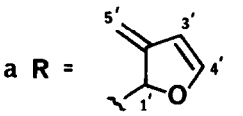

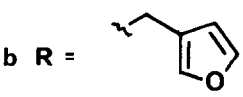

Table 1. ^{1}H NMR Spectral Data (360 MHz, $CDCl_3$, δ) for Marislin (1a), Pleraplysillin-2 (1b) and the Minor Metabolites 2 and 3.

H at C-#	1a	1b	2a	2b	3a	3b
2	5.72 (bs)[a]	5.69 (bs)[b]	5.73 (bs)	5.69 (bs)	5.73 (bs)	5.71 (bs)
4,5	≈ 2.2 (m, 4 H)		≈ 2.2 (m, 4 H)		≈ 2.2 (m, 4 H)	
6	5.18 (t, J = 7 Hz)		5.20 (t, J = 7 Hz)		5.17 (t, J = 7 Hz)	
8	3.22 (s, 2 H)		3.02 (s, 2 H)		2.54 (d, J = 17 Hz) 2.61 (d, J = 17 Hz)	
10	5.86 (s)		2.2 (m, 2 H)		6.68 (bs)	
11	-		2.15 (m)		-	
12	7.06 (s)				-	
13	1.98 (s, 3 H)		0.89 (d, 6 H, J = 6 Hz)		1.93 (bs, 3 H)	
14	1.60 (bs, 3 H)		1.61 (bs, 3 H)		1.65 (bs, 3 H)	
15	2.20 (bs, 3 H)		2.20 (bs, 3 H)		2.16 (bs, 3 H)	
1'	6.88 (s)	7.49 (s)	6.88 (s)	7.49 (s)	6.88 (s)	7.48 (s)
3'	5.68 (s)	6.45 (s)	5.69 (s)	6.44 (s)	5.69 (s)	6.44 (s)
4'	6.77 (s)	7.41 (s)	6.77 (s)	7.41 (s)	6.77 (s)	7.40 (s)
5'	5.05 (s) 5.13 (s)	5.01 (s, 2 H)	5.03 (s) 5.15 (s)	5.01 (s, 2 H)	5.03 (s) 5.15 (s)	5.01 (s, 2 H)
-OMe					3.18 (s, 3 H)	

[a] All signals due to one proton unless otherwise designated. [b] See reference 4.

REFERENCES AND NOTES

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4. There is a systematic error between the ^{1}H NMR chemical shift values reported for pleraplysillin-2 (1b) in CCl_4 solution at 100 MHz[5] and those that we measured in $CDCl_3$ solution at 360 MHz (Table 1).

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7. ^{13}C NMR (C_6D_6) δ 188.8 (s, C-1), 165.1 (s, C-2'), 162.3 (s, C-3), 154.5 (s, C-9), 152.7 (d, C-4'), 138.2 (d, C-12), 133.0 (s, C-7), 125.4 (d, C-6), 120.7 (s, C-11), 115.4 (d, C-2), 109.2 (d, C-10), 105.6 (d, C-3'), 105.2 (t, C-5'), 96.3 (d, C-1'), 40.7 (t, C-4), 38.7 (t, C-8), 26.0 (t, C-5), 19.0 (q, C-15), 15.9 (q, C-14), 9.8 (q, C-13).

8. We did not attempt any heroic methods for separation of the mixtures due to lack of material (3-4 mg of each mixture). For the same reason, we were unable to record optical rotations or ^{13}C NMR spectra for the minor metabolites 2 and 3.

9. We have not discovered a source of marisilin (1a) or pleraplysillin-2 (1b) among more than twenty common sponges of the Gulf of California.

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