

TWO POLYPROPIONATE METABOLITES
FROM THE CEPHALASPIDEAN MOLLUSK
PHILINOPSIS SPECIOSA

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Abstract -- Two polypropionate compounds, niuhinone-A and -B were isolated from a mollusk, Philinopsis speciosa, and their structures were elucidated by spectral methods.

We recently reported the structure of pulo'upone (1),¹ which is a trace constituent of Philinopsis speciosa, an endemic Hawaiian mollusk characterized by a prominent head shield and a thin internal shell. The animal feeds on other mollusks at night, when it may be found in sandy tidepools during the summer months. The principal organic constituents are polypropionate compounds, niuhinone-A² (4,6,8,10,12,14,16-heptamethylheptadeca-(E,E,E,Z)-6,8,11,14-tetraen-3,5,13-trione, 2) and -B (4,6,8,10,12,14,16-heptamethyloctadeca(E,E,E,E)-6,8,11,14-tetraen-3,5,13-trione, 3).³ They are structurally related to aglajne-1 (4), which was isolated by Cimino *et al.*⁴ from Aglaja depicta, also a member of the cephalaspidean family Aglajidae.

The animals (59 individuals) were collected at night in tidepools at Pupukea, O'ahu during June and July, 1983. The freeze-dried animals (77.5 g) were repeatedly extracted with hexane at room temperature, yielding 1.17 g of an oily residue, which was purified successfully by chromatography on Sephadex LH 20 (CH₂Cl₂/1-PrOH, 1:1), C₁₈ Bond Elut⁵ (MeCN), HPLC (Bondapak C₁₈,⁶ MeCN then MeCN/H₂O, 7:3), resulting in 18 mg (0.023%) of niuhinone-A (2) and 41 mg (0.052%) of -B (3).

Niuhinone-A (2) is a colorless oil, [α]_D +55° (c 0.68, hexane); $\lambda_{\max}^{\text{EtOH}}$ 238(10,500), 285(10,400) nm; ν_{\max}^{film} 2960, 2870, 1725, 1660, 1638, 1458, 1375, 1309, 1038, 737 cm⁻¹; HRMS: m/z 372.2694 (C₂₄H₃₆O₃ requires 372.2722).

Niuhinone-B (3) is a colorless oil, [α]_D +72° (c 0.47, hexane); $\lambda_{\max}^{\text{EtOH}}$ 237(15,200), 284(10,300) nm; ν_{\max}^{film} 2966, 2872, 1725, 1660, 1637, 1458, 1379, 1037, 737 cm⁻¹; HRMS: m/z 386.2818 (C₂₅H₃₈O₃ requires 386.2821). Since B was the more abundant of the two compounds, it was used for the structural elucidation which was hampered by its extreme lability to light and ambient temperatures. ¹H and ¹³C NMR data in

different solvents (Table 1) including COSY and selective decoupling experiments revealed a carbon skeleton identical with that of aglajne-1 (4).⁴ Observed mass spectral fragmentation (see 3) is in full agreement with this structure. E-stereochemistry of all four double bonds is evident from the NMR data (Table 1).

Mass spectral data provide evidence that niuhinone-A differs from B by one methylene group. This is reflected in the ¹H NMR spectra of the two compounds. In the high-field methyl region three doublets (δ 0.97, 1.15, 1.26) and two triplets (δ 0.93, 0.87) in B are replaced by four doublets (δ 1.01, 1.01, 1.15, 1.28) and one triplet (δ 0.98) in A. Concomitantly, two methylene multiplets at δ 1.37 and 1.47 in the spectrum of B are absent in A. No other differences were apparent in the NMR spectra of the two compounds, which was proven by detailed spectral analysis analogous to B. Since the compounds are acyclic and of polypropionate biogenesis, an isobutyl terminus in B is replaced by isopropyl in A. This simple structural variation left unexplained the striking difference in absorption intensity of the short wavelength (237 nm) uv band: ϵ 10,500 in A vs 15,200 in B. In both compounds the long wavelength (285 nm) uv band arises from a conjugated dienone, whose carbonyl group is part of the β -diketone chromophore. The 237 nm maximum is compatible with a dialkyl enone, which must be cross-conjugated as there is no spectral evidence for an isolated double bond.

A plausible explanation for this difference in absorption intensity is suggested by the uv behavior of the two compounds upon base treatment. When a drop of 10% NaOH solution is added to the sample, both compounds experience a bathochromic shift with a new maximum at 312 nm, which no doubt arises from enolization of the C-5 ketone. When the basic samples are neutralized with HCl, the spectrum of niuhinone-A (2) does not revert to its original but instead to a uv spectrum which is superimposable on the UV spectrum of niuhinone-B (3). Apparently, the C-14,15 olefin in A has Z stereochemistry, which is irreversibly transformed to E by the base-acid treatment. The lower absorption intensity of the 237 nm chromophore is compatible with a rather hindered stereochemistry of the enone moiety.

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References and Notes

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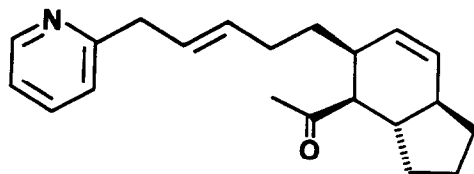
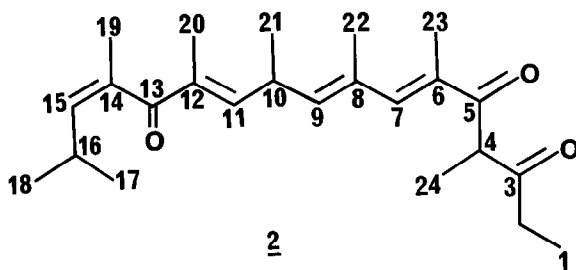
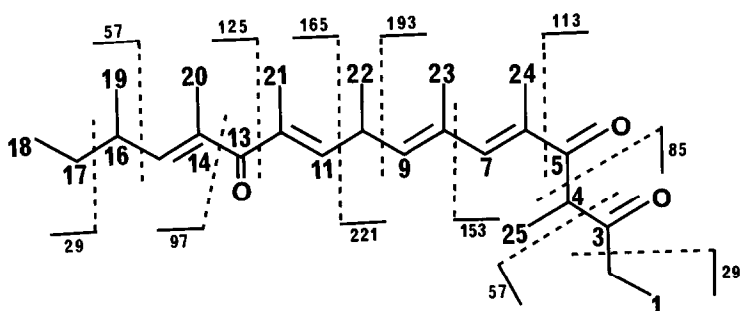
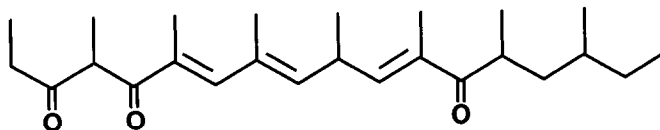
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Table 1. NMR Data (300 MHz) for Niuhinone-B (3)

C #	^{13}C , δ			^1H , δ			mult.	\underline{J} (Hz)
	CD_2Cl_2	C_6D_6	mult.	CD_2Cl_2	C_6D_6	$(\text{CD}_3)_2\text{CO}$		
1	7.9	8.0	q	0.99	0.90	0.93	t	6.9
2	33.4	33.2	t	2.3-2.4	2.0-2.2	2.4	m	---
3	208.2	206.7	s	---	---	---	---	---
4	\approx 55.2	55.2	d	4.28	3.89	4.54	q	7.0
5	200.6 ^a	198.9 ^a	s	---	---	---	---	---
6	134.9	135.2	s	---	---	---	---	---
7	144.0	143.0	d	6.94	6.85	7.14	br s	---
9	139.5	139.0	d	5.50	5.37	5.62	br d	8.1
10	33.4	33.2	d	3.58	3.39	3.68	m	---
11	144.4	143.7	d	5.96	5.98	6.02	br d	8.1
12	135.0	135.4	s	---	---	---	---	---
13	200.9 ^a	199.8 ^a	s	---	---	---	---	---
14	135.1	135.4	s	---	---	---	---	---
15	149.0	147.8	d	5.92	5.95	5.94	br d	7.3
16	34.4	35.1	d	2.45	2.2	2.45	m	---
17	30.2	30.1	t	1.2-1.5	1.1-1.3	1.4-1.5	m	---
18	13.0 ^a	13.2 ^a	q	0.87	0.73	0.87	t	7.4
19	19.9	19.9 ^a	q	0.97	0.81	0.98	d	7.1
20	13.5 ^a	13.7 ^a	q	1.80	1.89	1.79	d	1.4
21	12.1 ^a	11.0 ^a	q	1.87	1.92	1.87	d	1.4
22	20.5	20.4	q	1.15	0.90	1.16	d	6.7
23	16.9	16.9	q	1.92	1.57	1.96	d	1.5
24	13.3 ^a	13.5 ^a	q	1.92	1.95	1.92	d	1.5
25	14.2 ^a	14.1 ^a	q	1.26	1.22	1.20	d	7.0

^a may be interchanged

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