New Approach to 6-Chlorosalicylates and 1-Hydroxyacridones

Osmo E. O. Hormi

Department of Organic Chemistry, Åbo Akademi, Akademigatan 1, SF-20500 Åbo, Finland

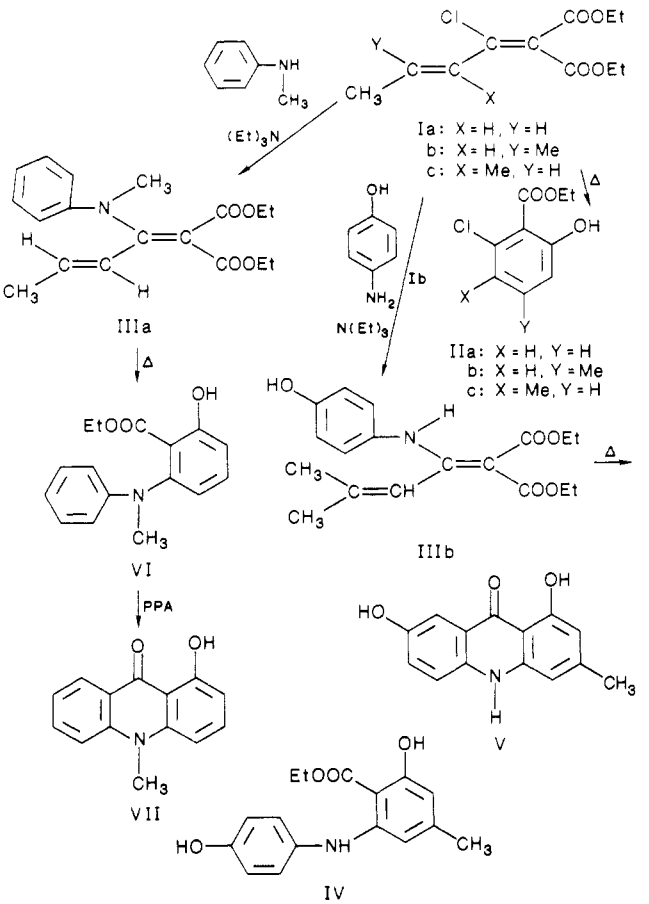
Received May 13, 1987

We have been interested in the utilization of RC(Cl)=C(COOEt)$_2$ as starting materials in synthetic work because of their accessibility in large quantities from readily available acylmalonates.[1] A fundamental property of the chloro malonates relates to the S_NV reaction that materializes upon treatment of the malonates with nucleophiles. We have previously shown that a method for the synthesis of flavone-3-carboxylic acid and related compounds is the addition of a phenolic nucleophile to a chloro malonate followed by cyclization.[2]

Another feature common to all the chloro malonates is the R substituent. So far, our efforts to utilize R have focused on elaboration of aromatic substituents suitable for introduction of the aryl moiety into the 2-position of flavone-3-carboxylic acid and related compounds. Another work in our laboratory has shown that R can also be a part of a 2-pyrone ring.[2]

I now extend the previous work to 1-propenyl substituents. I report that under conditions that promote thermolysis of the chloro malonates, 1-propenyl substituents undergo cyclization[3] with one of the ester groups to give 6-chlorosalicylates.[4] As an application of the finding, I describe the use of this cyclization as the key transformation in a new approach to 1-hydroxyacridones.[5]

Scheme I



Results and Discussion

The conversion of acylmalonates into the required chloro malonates Ia, Ib, and Ic was achieved by adding tributylamine to a solution of acylmalonates in phosphorus oxychloride at 0 °C, stirring the solution at room temperature overnight, and then heating the mixture at 85 °C for 1–3 h. The products were separated by simple extraction with warm petroleum ether (90–100 °C) (cf. the multistage extraction procedure reported previously[1]) to give 60–80% yield of the crude chloro malonates I.

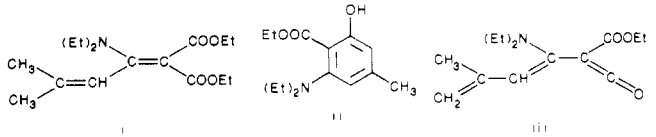
Thermolysis of the chloro malonates was carried out by using a distillation apparatus. The malonates were heated at 240 °C with stirring until the evolution of ethanol had subsided and then distilled at reduced pressure to give the 6-chlorosalicylates in 70–80% yield (Scheme I).

It having been established that chloro malonates could be successfully ring closed, the anilino malonates IIIa and IIIb were examined in the hope of inducing a similar cyclization. From the outset it was recognized that the anilino malonates could result from a S_NV reaction of an appropriately substituted aniline with the desired chloro malonate.[2] Replacement of chlorine by an anilino group

(1) Hormi, O. E. O. *Syn. Commun.* **1986**, *16*, 997.

(2) (a) Hormi, O. E. O.; Moisio, M. R.; Sund, B. C. *J. Org. Chem.* **1987**, *52*, 5272. (b) Hormi, O. E. O.; Paakkanen, A. M. *J. Org. Chem.* **1987**, *52*, 5275.

(3) When the thermolysis of i was carried out either in the presence or in the absence of nucleophiles, some evidence for the formation of an intermediate ketene was obtained. Thus the malonate was thermolyzed



in mesitylene at 160 °C for 6 h to give the expected anthranilate ii. In the presence of a nucleophile (4-heptanol as solvent), the ring closure was completely inhibited. The major product in that thermolysis (160 °C, 6 h) was the reesterified malonate along with some starting material. These observations can be rationalized in terms of formation of the intermediate ketene iii that cyclizes in the absence of nucleophiles and captures the nucleophile in the presence of nucleophiles. For related chemistry, see: (a) Ward, R. S. In *The Chemistry of Ketenes, Allenes and Related Compounds*; Patai, S., Ed.; Wiley-Interscience: Chichester, England, 1980; p 233. (b) Brown, R. F. C.; Eastwood, F. W. In *The Chemistry of Ketenes, Allenes, and Related Compounds*; Patai, S., Ed.; Wiley-Interscience: Chichester, England, 1980; p 757. (c) Brown, R. F. C. *Pyrolytic Methods in Organic Chemistry*; Academic: New York, 1980; pp 121 and 294–297. (d) Hickson, C. L.; Keith, E. M.; Martin, J. C.; McNab, H.; Monahan, L. C.; Walkinshaw, M. D. *J. Chem.* Soc., *Perkin Trans. 1* **1986**, 1465. (e) McNab, H.; Monahan, L. C. *J. Chem. Soc., Chem. Commun.* **1987**, 138. (f) McNab, H.; Monahan, L. C.; Gray, T. *J. Chem. Soc., Chem. Commun.* **1987**, *140*. (g) Ward, R. S. In *the Chemistry of Ketenes, Allenes and Related Compounds*; Patai, S., Ed.; Wiley-Interscience: Chichester, England, 1980; pp 258–263. (h) Besida, J.; Brown, R. F. C. *Aust. J. Chem.* **1982**, *35*, 1385 and earlier papers in the series. (i) Briehl, H.; Lukosch, A.; Wenturp, C. *J. Org. Chem.* **1984**, *49*, 2772. (j) Moore, H. W.; Decker, O. H. W. *Chem. Rev.* **1986**, *86*, 821.

(4) A striking feature of 6-chlorosalicylate is that although it has a fairly simple structure, its synthesis requires several steps; see: Dauben, R. C.; Hodgson, R. L. *J. Am. Chem. Soc.* **1950**, *72*, 3479 and references therein. A low-yield one-step procedure: Durrani, A. A.; Tyman, J. H. P. *J. Chem. Soc., Perkin Trans. 1* **1979**, 2069. Other processes which produce phenols by ring closure of nonaromatic starting materials: Wedemeyer, K. F. In *Houben-Weyl Methgoden der Organischen Chemie*; Müller, E., Ed.; Thieme Verlag: Stuttgart, 1976; 6/1c, pp 858 ff. Bamfield, P.; Gordon, P. F. *Chem. Soc. Rev.* **1984**, *13*, 441.

(5) For synthesis of 9-acridones, see: (a) Gagan, J. M. F. In *Acridines, The Chemistry of Heterocyclic Compounds*; Acheson, R. M., Ed.; Wiley: New York, 1973; Chapter III. (b) Iwao, M.; Reed, J. W.; Snieckus, V. *J. Am. Chem. Soc.* **1982**, *104*, 5531. (c) Watanabe, M.; Kurosaki, A.; Furukawa, S. *Chem. Pharm. Bull.* **1984**, *32*, 1264. (d) Rewcastle, G. W.; Denny, W. A. *Synthesis* **1985**, 217 and 220. (e) Scherrer, R. A.; Beatty, H. R. *J. Org. Chem.* **1980**, *45*, 2127. (f) A hydroxy group at position 7 of 1,7-dihydroxy-9-acridone is usually introduced by means of a nitro group, which is then hydrogenated and hydrolyzed, private communication with Prof. Dr. Med. J. Reisch. (g) Probst, W.; Reisch, J. Poster at "34. Vortragstagung der Gesellschaft für Arzneipflanzenforschung", Hamburg, 22–27 Sept 1986.

0022-3263/88/1953-0880$01.50/0

in the chloro malonates Ia and Ib was effected by treatment with *N*-methylaniline and *p*-hydroxyaniline, respectively, in the presence of triethylamine. The anilino malonate IIIb was produced in 55% yield. Although this material could be purified, it was more convenient to thermolyze it directly. Interestingly, the thermolysis at 240 °C gave none of the expected anthranilate IV. Instead, the anilino group underwent a Conrad–Limpach-type cyclization simultaneously with the ring closure of the 1-propenyl substituent to give the acridone V in 38% over the two steps.

No attempts were made to isolate IIIa. Instead, the crude anilino malonate was thermolyzed directly to the anthranilate VI in 56% overall yield.

At the outset it was envisaged that the acridone VII could be formed by means of an acidic cyclization of VI.[2] The cyclization was carried out in 70% yield by treatment with polyphosphoric acid at 160 °C for 45 min.

Experimental Section

Melting points are uncorrected, and they wre determined on a Gallenkampf melting point apparatus. NMR spectra were measured with Perkin-Elmer R-12 or JEOL FX-60 spectrometers, and chemical shifts are reported relative to internal Me_4Si. IR spectra were obtained on a Perkin-Elmer 275 IR spectrometer, and wavenumbers are reported in cm^{-1}. Mass spectra were recorded by M. Reunanen on a WG 7070 E instrument.

Preparation of the Crude Chloro Malonates Ia–c. A solution of acylmalonates $RCOCH(COOEt)_2$ (R = $CH{=}CHCH_3$, $CH{=}C(CH_3)_2$, and $C(CH_3){=}CHCH_3$) (1 mol) in phosphorus oxychloride (5 mol) was cooled to −10 °C. Tributylamine (1 mol) was added dropwise with stirring below 0 °C. The mixture was allowed to warm to room temperature, then stirred at this temperature overnight, and finally heated at 85 °C for 3 h. Phosphorus oxychloride was removed with a rotary evaporator under vacuum, and the residue was extracted with three 300-mL portions of boiling petroleum ether (90–100 °C). The combined petroleum ether layers were washed with 20% potassium carbonate solution, then with 5 mol/L hydrochloric acid, and finally with water. The organic phase was dried (Na_2SO_4) and concentrated under reduced pressure to leave the crude chloro malonates I in 60–80% yield.

^{1}H NMR Spectral Data of the Chloro Malonates. Ethyl 3-chloro-2-(ethoxycarbonyl)hexa-2,4-dienoate (Ia): (CCl_4) δ 1.23 (t, 7.0 Hz), 1.27 (t, 7.0 Hz, 6 H), 1.95 (dd, 6.7 Hz and 3 Hz, 3 H), 4.10 (q, 7.0 Hz), 4.15 (q, 7.0 Hz, 4 H), 6.55 (qd, 14.7 Hz and 6.7 Hz, 1 H), 7.35 (dq, 14.7 Hz and 1.3 Hz, 1 H).

Ethyl 3-chloro-2-(ethoxycarbonyl)-5-methylhexa-2,4-dienoate (Ib): (CCl_4) δ 1.25 (t, 6.9 Hz), 1.30 (t, 6.9 Hz, 6 H), 1.85 (d, 1.3 Hz, 6 H), 4.05 (q, 6.9 Hz), 4.18 (q, 6.9 Hz, 4 H), 6.18 (m, 1.3 Hz, 1 H).

Ethyl 3-chloro-2-(ethoxycarbonyl)-4-methylhexa-2,4-dienoate (Ic): (CCl_4) δ 1.20 (t, 6.7 Hz), 1.28 (t, 6.7 Hz) 6 H, 1.68 (d 7.0 Hz), 1.80 (s) 6 H, 4.05 (q 6.7 Hz), 4.18 (6.7 Hz) 4 H, 5.6 (q 7.9 Hz) 1 H.

Thermolysis of the Chloro Malonates. Preparation of Ethyl 2-Chloro-6-hydroxybenzoate (IIa). A 10-g (40 mmol) sample of the chloro malonate Ia was heated in a distillation apparatus with stirring in an oil bath at 240 °C until the evolution of ethanol had subsided (about 20 min). The temperature was allowed to cool to 150 °C, and the mixture was then distilled at reduced pressure to give the product: 5.9 g, 73%; bp 138–140 °C (22 mmHg); NMR (CCl_4) δ 1.40 (t, 6.7 Hz, 3 H), 4.30 (q, 6.7 Hz, 2 H), 6.60–7.35 (3 H), 10.90 (br, 1 H); IR (CCl_4) 3060 (w), 2990 (m), 1670 (s), 1450–1190 cm^{-1} (several strong bands); MS (direct inlet), *M* calcd for $C_9H_9ClO_3$ 202.021/200.024, M^+ 202.022 (9)/200.023 (30), 156 (33), 154 (100), 128 (8), 126 (22).

A similar thermolysis of Ib gave **ethyl 2-chloro-6-hydroxy-4-methylbenzoate (IIb):** 76% yield; bp 149–151 °C (18 mmHg); NMR (CCl_4) δ 1.43 (t, 6.8 Hz, 3 H), 2.22 (s, 3 H), 4.35 (q, 6.8 Hz, 2 H), 6.53 (d, 1.3 Hz) and 6.65 (d, 1.3 Hz) (tot 2 H), 11.5 (1 H); IR (CCl_4) 2990 (m), 1670 (s), 1400–1050 cm^{-1} (several strong bands); MS (direct inlet), *M* calcd for $C_{10}H_{11}ClO_3$ 216.0367/214.0396, M^+ 216.037 (8)/214.039 (20), 170 (33), 168 (100), 140 (13).

Ethyl 2-chloro-6-hydroxy-3-methylbenzoate (IIc): 79% yield; bp 146–148 °C (18 mmHg); NMR (CCl_4) δ 1.42 (t, 6.7 Hz, 3 H), 2.25 (s, 3 H), 4.33 (q, 6.7 Hz, 2 H), 6.66 (d, 9.3 Hz, 1 H), 7.12 (d, 9.3 Hz, 1 H), 9.90 (1 H); IR (CCl_4) 2990 (m), 1670 (s), 1470–1200 cm^{-1} (several strong bands); MS (direct inlet), *M* calcd for $C_{10}H_{11}ClO_3$ 216.0357/214.0396, M^+ 216.033 (9)/214.036 (25), 170 (34), 168 (100), 140 (18).

Preparation of Ethyl 2-(Ethoxycarbonyl)-3-(*p*-hydroxyanilino)-5-methylhexa-2,4-dienoate (IIIb). A mixture of the chloro malonate Ib (39 g, 0.15 mol), *p*-hydroxyaniline (17 g, 0.156 mol), and triethylamine (16 g, 0.16 mol) in toluene (40 mL) was heated at 85 °C with stirring for 12 h. Chloroform (100 mL) was added, the mixture was then washed with water, and the chloroform layer was evaporated, to give a dark-colored residue of crude IIIb. Methanol (200 mL) was added to the crude product, and the anilino malonate IIIb crystallized (27 g, 54%) with time: mp 141–143 °C; ^{1}H NMR ($CDCl_3$) δ 1.26 (t, 6.95 Hz, 6 H), 1.50 (d, 0.98 Hz, 3 H), 1.61 (d, 1.10 Hz, 3 H), 4.18 (q, 6.95 Hz, 4 H), 5.74 (m, 1 H), 6.80 (4 H), 7.28 (1 H), 10.9 (1 H); IR (KBr) 3300 (s), 2980 (m), 1660 (s), 1570 (s), 1250 cm^{-1} (s); MS calcd for $C_{18}H_{23}NO_5$ 333.1576, M^+ 333.1576 (63), 288 (18), 260 (11), 241 (100), 214 (27), 174 (72).

Preparation of Ethyl 6-(Methylphenylamino)-2-hydroxybenzoate (VI). The chloro malonate Ia (12 g, 50 mmol), *N*-methylaniline (6 g, 56 mmol), and triethylamine (6 g, 60 mmol) were heated at 90 °C with stirring for 12 h, whereafter chloroform (100 mL) was added. The mixture was washed with water and the chloroform layer evaporated. The residue was thermolyzed by the method described for preparation of the salicylate IIa to give 7.6 g (56%) of VI, bp 215–230 °C (18 mmHg). The product crystallized with time: mp 53–55 °C (from ethanol); ^{1}H NMR (CCl_4) δ 0.98 (t, 7.1 Hz, 3 H), 3.13 (s, 3 H), 3.95 (q, 7.1 Hz, 2 H), 6.30–7.45 (8 H), 10.7 (1 H); IR (KBr) 3300 (w), 2980–2800 (w), 1665 (s), 1600 (s), 1500–1000 cm^{-1} (several strong bands); MS, calcd for $C_{16}H_{17}NO_3$ 271.1208, M^+ 271.1193 (75), 225 (100), 197 (15).

Preparation of 1,7-Dihydroxy-3-methyl-9-acridone (V). Crude IIIb was prepared from the chloro malonate Ib (5.2 g, 20 mmol), *p*-hydroxyaniline (2.2 g, 20.2 mmol), and triethylamine (2.2 g, 22 mmol) as described before. The crude product was heated in vacuum (20–40 mmHg) at 240 °C with stirring until the mixture had solidified completely (30 min–1 h). The cake was pulverized, methanol (20 mL) was added, and the heterogeneous mixture was refluxed with stirring for 10 min and then filtered while hot to give the product: 1.85 g, 38%; mp >350 °C. This product is sufficiently pure for most purposes: one spot on TLC (SiO_2, chloroform/methanol, 90/10), R_f 0.54. Further purification is difficult owing to lack of suitable solvents. The acridone is soluble in pyridine, dimethylformamide, dimethyl sulfoxide, and methoxyethanol, but cannot be efficiently recrystallized from these solvents. Formic acid (85%) can be used, but the yield is low (30%). ^{1}H NMR (DMSO-d_6 + $CDCl_3$): δ 2.25 (s, 3 H), 6.15 (1 H), 6.55 (1 H), 7.00–7.50 (3 H), 9.30 (1 H), and 11.40 (1 H). IR (KBr): 3450 (s), 3300 (s), 1650 (s), 1610–1590 (s), 1485 (s), 1380 (s), and 1280 cm^{-1} (s). MS, calcd for $C_{14}H_{11}NO_3$ 241.0738, M^+ 241.0738, (100), 212 (11).

Preparation of 1-Hydroxy-10-methyl-9-acridone (VII). The anthranilate VI (1.0 g, 3.7 mmol) was heated in polyphosphoric acid (10 g) for 45 min and was then poured into cold water, filtered, and recrystallized from ethanol to give 0.58 g (70%) of the product: mp 190 °C (lit.[7] mp 190 °C); ^{1}H NMR ($CDCl_3$ + DMSO-d_6) δ 3.72 (s, 3 H), 6.30–8.25 (tot 7 H), 14.3 (1 H); IR (KBr) 3050 (w), 2930 (w), 1630 (s), 1600 (s), 1500 (s), 1470 (s), 1300–1100 cm^{-1} (several strong bands); MS (direct inlet), 225 (100), 182 (11).

Acknowledgment. I thank M. Reunanen for mass spectra. Research and Science Foundation of Farmos is acknowledged for financial support. I am indebted to P. Pennanen and M. Lukola for typewriting.

Registry No. Ia, 112270-03-8; **Ib**, 112270-04-9; **Ic**, 112270-05-0; **IIa**, 112270-06-1; **IIb**, 112270-07-2; **IIc**, 112270-08-3; **IIIb**,

(6) Conrad–Limpach quinoline synthesis probably involves ketenic intermediates. Borrmann, D. In *Houben-Weyl Methoden der Organischen Chemie*; Müller, E., Ed.; Thieme Verlag: Stuttgart, 1968; 7/4, p 87.

(7) Hughes, G. K.; Matheson, N. K.; Norman, A. T.; Ritchie, E. *Aust. J. Sci. Res., Ser. A* **1952**, *5*, 1952. *Chem. Abstr.* **1953**, *47*, 2176.

112270-09-4; **V**, 112270-10-7; **VI**, 112270-11-8; **VII**, 16584-54-6; Me_2C=CHCOCH$(CO_2Et)_2$, 27761-58-6; MeCH=C(Me)COCH$(CO_2Et)_2$, 27761-60-0; MeCH=CHCOCH$(CO_2Et)_2$, 27761-57-5; *p*-hydroxyaniline, 123-30-8; *N*-methylaniline, 100-61-8.

Oxidized Nakafuran 8 Sesquiterpenes from the Sponge *Dysidea etheria*. Structure, Stereochemistry, and Biological Activity[1]

John H. Cardellina II* and David E. Barnekow

Natural Products Laboratory, Department of Chemistry, Montana State University, Bozeman, Montana 59717

Received June 16, 1987

We have been engaged for some time in a study of the metabolites of the distinctively blue-colored sponge *Dysidea etheria* and have previously reported the isolation of ceramides,[2] the sesquiterpenes furodysinin, furodysinin lactone,[3] and dysetherin,[4] and indoles[5] from the organic extracts of the sponge. Our study of the secondary metabolites of *D. etheria* has also resulted in the isolation of three additional new furanosesquiterpenes;[6] the complete structure elucidation and the biological testing of these compounds comprise this report.

Results and Discussion

Specimens of *Dysidea etheria* were collected from a variety of calm, shallow water locations in Bermuda on three occasions—October 1979, August 1982, and July 1984. The extraction of the 1979 and 1982 collections and subsequent crude fractionation of the extracts have been described earlier.[3] A nonpolar Florisil fraction, eluted with hexane–ethyl acetate (24:1), contained a pleasant smelling yellow oil. Gel permeation chromatography of this material through Bio-Beads S-X8 with dichloromethane–cyclohexane (3:2) yielded **1** as a colorless oil (5.5% of the total extract).

A 2,3-disubstituted furan was evident from the ^1H NMR doublets at δ 7.12 and 6.09 ($J \approx 1.5$ Hz) and ^{13}C NMR signals at δ 150.0 (s), 138.6 (d), 114.6 (s), and 113.7 (d). An acetate ester was indicated by a wealth of data: a three-proton singlet at δ 2.05, a ^{13}C NMR carbonyl signal at δ 170.0, a carbonyl stretch at 1735 cm^{-1} in the IR, and major mass spectral fragment ions at m/z 232 (M − 42) and 214 (M − 60). High resolution mass spectral analysis established $C_{17}H_{22}O_3$ as the molecular formula, suggesting that **1** was a sesquiterpene monoacetate.

^1H NMR decoupling experiments at 250 MHz led to two additional part structures, **1a** and **1b**, which accounted for all but two carbons in **1**, one quaternary (δ 44.4, s) and the other a quaternary methyl group (δ 1.02, s, and 17.5 q). The allylic methine in **1a** had to be connected to the furan ring to account for its chemical shift (δ 3.46, m). In **1b**, the chemical shift (δ 4.96, dd, J = 10, 6) of the X proton in the ABX system indicated that its carbon (δ 83.5) was the likely point of attachment of the acetate, while the AB methylene (δ 2.51, two overlapping 1 H, dd, J = 13, 10 and J = 13, 6) was connected to the furan. Assembly of all the pieces thus gave **1**.

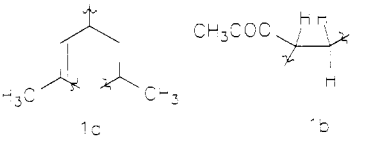
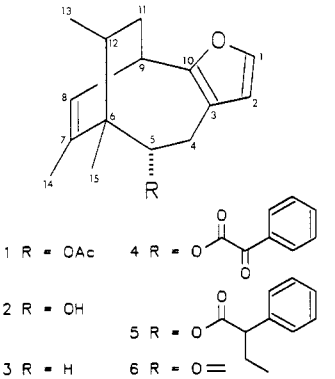


Table I. LIS Study of 5-Hydroxynakafuran 8 (2)

proton	slope[a]	$\Delta\delta^b$
H_1	0.017	0.67
H_2	0.024	0.97
H_{4a}	0.256	7.79
H_{4b}	0.206	7.11
H_5	0.348	13.35
H_8	0.081	3.16
H_9	0.060	2.33
H_{11a}	0.062	2.39
H_{11b}	0.065	2.51
H_{12}	0.103	4.00
H_{13}	0.047	1.79
H_{14}	0.120	4.69
H_{15}	0.151	5.82

[a] $\Delta\delta$ (y) vs mg of Eu(fod)$_3$ (x). [b] Extrapolated to 1 equiv of Eu(fod)$_3$.

Attempted hydrolysis of **1** with alcoholic KOH gave a low yield of **2** and considerable decomposition, but conversion to the alcohol was achieved in good yield by treatment with $Ba(OH)_2$.[7] The structure **2** was fully supported by loss of the acetate methyl and a shift of the heteroatom bearing methine from δ 4.96 (**1**) to 3.69 in the ^1H NMR of **2**, together with the mass spectral data (m/z 232, M^+, $C_{15}H_{20}O_2$).



1 R = OAc
2 R = OH
3 R = H
4 R = O
5 R = O
6 R = O=

Lanthanide-induced chemical shift studies of the alcohol **2** with Eu(fod)$_3$ supported the proposed structures and prescribed the relative configuration shown in **1** and **2**; Table I summarizes the relevant data. The difference in the induced shifts for H_1 and H_2 required placement of the furan oxygen as shown; in a similar fashion, the relative stereochemistry at C-5, C-6, and C-12 was deduced by comparison of the relative shifts induced for H_{12}, H_{13}, H_{14}, and H_{15}. The induced shifts for H_{14} and H_{15} are greater than those for H_{12} and H_{13}, indicating that the hydroxyl group is syn to the unsaturated bridge. The great difference between H_{12} and H_{13} required the methyl group to be positioned at a greater distance than the H_{12} methine from the lanthanide, resulting in the configuration shown. Analysis of the LIS data was aided significantly by the use of empirical force field calculations MM2[8] to determine

(1) Contribution No. 1056 from the Bermuda Biological Station.
(2) Grode, S. H.; Cardellina, J. H., II. *Lipids* **1983**, *18*, 107.
(3) Grode, S. H.; Cardellina, J. H., II. *J. Nat. Prod.* **1984**, *47*, 76.
(4) Schram, T. J.; Cardellina, J. H., II. *J. Org. Chem.* **1985**, *50*, 4155.
(5) Cardellina, J. H., II.; Nigh, D.; VanWagenen, B. C. *J. Nat. Prod.* **1986**, *49*, 1065.
(6) A preliminary report of the isolation of **1** and **2** has been made;[3] no details were provided.
(7) Cardellina, J. H., II.; Moore, R. E.; Arnold, E.; Clardy, J. *J. Org. Chem.* **1979**, *44*, 4039.
(8) (a) Burkert, U.; Allinger, N. L. *Molecular Mechanics*; American Chemical Society: Washington, D.C., 1982. (b) Allinger, N. L. *J. Am. Chem. Soc.* **1977**, *99*, 8127.

0022-3263/88/1953-0882$01.50/0