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X-RAY STRUCTURE OF CYPERENOIC ACID FROM *CROTON CRASSIFOLIUS*

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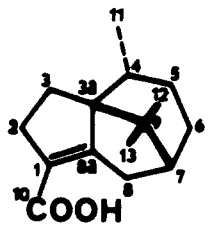
As part of our investigation of medicinal plants of the genus *Croton* (Euphorbiaceae) (1), we wish to report the isolation of cyperenoic acid [**1**] from *Croton crassifolius* Geisel and its characterization by X-ray diffraction. This substance, first prepared by oxidation of cyperenol (2), has also been found recently as a natural product in *Sandwithia guyanensis* (Euphorbiaceae) and characterized by nmr (3). Our X-ray study confirms the structure (except for absolute configuration) and makes available the atomic coordinates (Table 1). The two independent molecules in the unit cell are hydrogen-bonded to each other in the usual carboxylic acid dimer fashion (Figure 1; the intermolecular hydrogen-bonding O1–O2 distances are both about 2.6 Å). The molecules have similar chair cyclohexane conformations; the largest conformational difference between the two occurs in the rotation about the C1–C10 bond: torsion angle C8a-C1-C10-O2 is +5° in molecule 1 but −7° in molecule 2. The observed negative optical rotation shows the absolute configuration of **1** from this new source to be the same as that from other sources (2,3); we also reduced the acid **1** with $LiAlH_4$ to levorotatory cyperenol to confirm this.



1

TABLE 1. Atomic Coordinates and Their ESDs.

Atom	Molecule 1			Molecule 2		
	x	*y*	*z*	*x*	*y*	*z*
O-1	.783(1)	.2468(7)	.3936(3)	.523(1)	.4509(7)	.3761(3)
O-2	.535(1)	.2704(7)	.4270(3)	.741(1)	.4017(7)	.3326(3)
C-1	.684(2)	.115(1)	.4488(5)	.595(2)	.559(1)	.3080(5)
C-2	.838(2)	.052(1)	.4525(5)	.451(2)	.637(1)	.3131(5)
C-3	.804(2)	−.029(1)	.4941(5)	.502(2)	.731(1)	.2810(5)
C-3a	.617(2)	−.038(1)	.4973(4)	.638(2)	.685(1)	.2473(4)
C-4	.541(2)	−.134(1)	.4689(5)	.561(2)	.654(1)	.1952(5)
C-5	.358(2)	−.123(1)	.4649(5)	.685(2)	.588(1)	.1651(6)
C-6	.269(2)	−.079(1)	.5075(6)	.855(2)	.621(2)	.1698(6)
C-7	.357(2)	.012(1)	.5321(5)	.907(2)	.656(1)	.2212(5)
C-8	.397(2)	.101(1)	.4932(5)	.861(2)	.558(1)	.2557(5)
C-8a	.563(1)	.0677(9)	.4737(4)	.692(2)	.585(1)	.2727(4)
C-9	.533(2)	−.023(1)	.5485(5)	.801(2)	.747(1)	.2392(5)
C-10	.675(2)	.218(1)	.4222(5)	.620(2)	.469(1)	.3410(5)
C-11	.622(3)	−.154(2)	.4208(7)	.398(2)	.595(1)	.1988(6)
C-12	.533(2)	−.124(1)	.5798(6)	.794(2)	.844(1)	.2046(6)
C-13	.609(2)	.065(1)	.5774(6)	.866(2)	.787(1)	.2869(6)

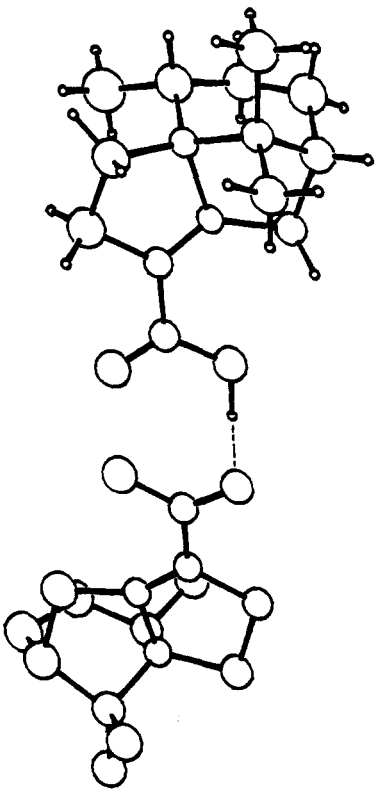


FIGURE 1. ORTEP drawing of the two independent molecules of **1** with 30% probability spheres for non-hydrogen atoms and arbitrarily small spheres for the hydrogen atoms of molecule 1. The dashed line indicates a hydrogen bond.

EXPERIMENTAL

Dried roots of *C. crassifolius* (10 kg; voucher specimen #16306, Royal Forest Department Herbarium, Ministry of Agriculture and Cooperative, Bangkok 10900, Thailand) were extracted with EtOH, and the EtOH solution was extracted with hexane. The hexane solution was extracted with 5% NaOH, and the aqueous solution was acidified with HCl and extracted with Et_2O. Evaporation of the Et_2O and Si gel chromatography of the residue, eluting with 25% $CHCl_3$/hexane, gave cyperenoic acid [**1**], 3.5 g, mp 166–168°, $[\alpha]^{25}D$ −7.7° ($CHCl_3$, c = 2.0); uv λ max 238 nm (ε 13764); ir 1649, 1673 cm^{-1}; nmr as reported in the literature (3).

X-RAY STUDY.[1]—$C_{15}H_{22}O_2$, 234.3 g/mol, orthorhombic, $P2_12_12_1$, a = 8.106(2), b = 12.357(5), c = 27.440(9) Å, Z = 8, D_c = 1.13 g/cm^3; Mo$K\alpha$, λ = 0.71073 Å. Crystal 0.20 × 0.25 × 0.50 mm, Syntex diffractometer, 2θ max = 45°, 1024 of 2093 reflections with $I > 2.5\sigma(I)$ used in refinement. Structure solved using MULTAN80 (4). Final full-matrix refinement (137 parameters) of non-hydrogen atoms (isotropic temperature factors, hydrogen atoms in calculated positions with 5.0 $Å^2$ temperature factors) using SHELX (5) gave R = 0.094.

ACKNOWLEDGMENTS

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[1]Atomic coordinates for this structure have been deposited with the Cambridge Crystallographic Data Centre and can be obtained on request from Dr. Olga Kennard, University Chemical Laboratory, Lensfield Road, Cambridge CB2 1EW, UK.