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THE MOLECULAR STRUCTURE OF 3′-DEMETHOXYNORISOGUAIACIN TRIACETATE FROM CREOSOTE BUSH (*LARREA TRIDENTATA*)

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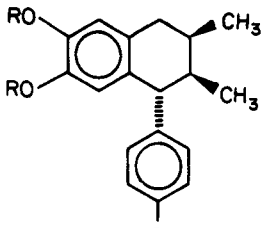
The creosote bush [*Larrea tridentata* (DC.) Cav.; Zygophyllaceae] is an abundant shrub of the arid and semiarid areas of the southwestern United States and northern Mexico and is commonly found in the Mojave, Sonora, and Chihuahua deserts (1). The resinous exudate of the creosote bush was the source for nordihydroguaiaretic acid (NDGA) when it was commercially used as a food antioxidant (2). Besides NDGA, several other lignans have been reported including the aryltetralin 3′-demethoxydemethylisoguaiacin [**1**] (3). Because of the amebicidal and fungicidal activities of *Larrea* lignans (1,4) and the limited amounts available for detailed spectral studies on the aryltetralins **1** and **2**, single crystal X-ray data of the triacetate [**2**] were obtained to eliminate structural uncertainties.

Fractional coordinates for **2** are given in Table 1,[1] and its molecular structure is illustrated in Figure 1. The relative configurations of the three chiral centers C1, C2, and C3 are determined: the methyl groups at C2 and C3 and *cis* to each other and are *trans* to the aromatic substituent at C1. The aromatic ring C5 through C10 is nearly planar, with all atoms lying within 0.022 (4) Å of a common plane. The ring C13 through C18 is more planar, exhibiting maximum deviation 0.008 (4) Å. The conformation of the molecule is such that these two planes are nearly orthogonal, forming a dihedral angle of 85.7°. Endocyclic torsion angles in the ring containing the chiral centers are 9.2° about C5-C10, −23.4° about C10-C1, 50.1° about C1-C2, −63.7° about C2-C3, 47.8° about C3-C4, and −21.8° about C4-C5. Bond distances are within normal limits with standard deviations 0.002-0.003Å.



1 R=H
2 R=Ac

EXPERIMENTAL

Leaves and small twigs (100 g) were extracted with $CHCl_3$ yielding 4% of a yellow resin. This material was separated by chromatography on a 65×2.5 cm dry column packed with 100 g of celite-polyvinylpyrrolidone (PVP) (1:1) and developed with a mixture of $CHCl_3$-MeOH (7:3). The fraction corresponding to a range of 0 to 0.2 Rf was extracted with $CHCl_3$ and acetylated with Ac_2O. Final purification involved column chromatography on Si gel developed with a mixture of $CHCl_3$-MeOH-methylethylketone (9.5:0.5:0.5) yielding 2.5% of the acetylated lignan.

A crystal of dimensions 0.24×0.24×0.48 mm was used for data collection on an Enraf-Nonius CAD4 diffractometer equipped with CuKα radiation (λ=1.54184Å) and a graphite monochromator. Crystal data are: $C_{24}H_{26}O_6$, MW=410.5, monoclinic space group $P2_1$, a=8.583 (1), b=12.779 (3), c=10.416 (2)Å, β=102.84 (1)°, Z=2, d_c=1.224 g cm^{-3}. Inten-

[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, U.K.

TABLE 1. Coordinates for 3′-Demethoxynorisoguaiacin Triacetate [2]

Atom	x	y	z	Atom	x	y	z
O1	0.0546(3)	0.2076[a]	0.8950(3)	C10	0.1457(4)	0.5110(3)	0.7797(3)
O2	0.2124(5)	0.1354(3)	0.7792(4)	C11	0.3523(5)	0.7805(4)	0.7691(6)
O3	−0.1731(3)	0.3117(2)	0.7131(3)	C12	0.5312(5)	0.5679(5)	0.7546(5)
O4	−0.2448(4)	0.3335(3)	0.9052(3)	C13	0.0285(4)	0.6851(3)	0.6859(3)
O5	−0.3897(3)	0.8607(3)	0.5681(3)	C14	−0.0280(5)	0.7114(4)	0.5578(4)
O6	−0.3081(7)	1.0012(5)	0.6817(10)	C15	−0.1684(5)	0.7736(4)	0.5129(4)
C1	0.1809(4)	0.6189(3)	0.7281(4)	C16	−0.2418(4)	0.8077(4)	0.6117(4)
C2	0.3111(5)	0.6767(4)	0.8232(4)	C17	−0.1872(4)	0.7835(4)	0.7406(4)
C3	0.4587(5)	0.6054(4)	0.8678(4)	C18	−0.0517(5)	0.7230(4)	0.7800(4)
C4	0.4144(5)	0.5111(5)	0.9444(4)	C19	0.1207(5)	0.1251(4)	0.8454(4)
C5	0.2599(4)	0.4596(4)	0.8732(4)	C20	0.0617(7)	0.0246(4)	0.8902(6)
C6	0.2332(5)	0.3568(4)	0.9094(4)	C21	−0.2771(5)	0.3010(4)	0.7949(5)
C7	0.0882(5)	0.3081(3)	0.8558(4)	C22	−0.4213(6)	0.2442(5)	0.7297(6)
C8	−0.0280(5)	0.3605(3)	0.7663(4)	C23	−0.4093(6)	0.9567(5)	0.6088(7)
C9	0.0030(4)	0.4598(3)	0.7260(4)	C24	−0.5764(6)	0.9935(5)	0.5679(6)

[a]The y coordinate of O1 was fixed to define the origin.

sity data were measured by $\omega-2\theta$ scans of variable speed, designed to yield $I \approx 50\sigma$ (I) for all significant reflections. One quadrant of data was measured within the limits $2°<\theta<75°$. Data reduction included corrections for background, Lorentz, and polarization effects; absorption effects were insignificant. Of a total of 2400 unique data, 1646 had $F>3\sigma$ (F) and were used in the refinement.

The structure was solved by direct methods, using program MULTAN 78(5), complete by Fourier techniques, and refined by full matrix

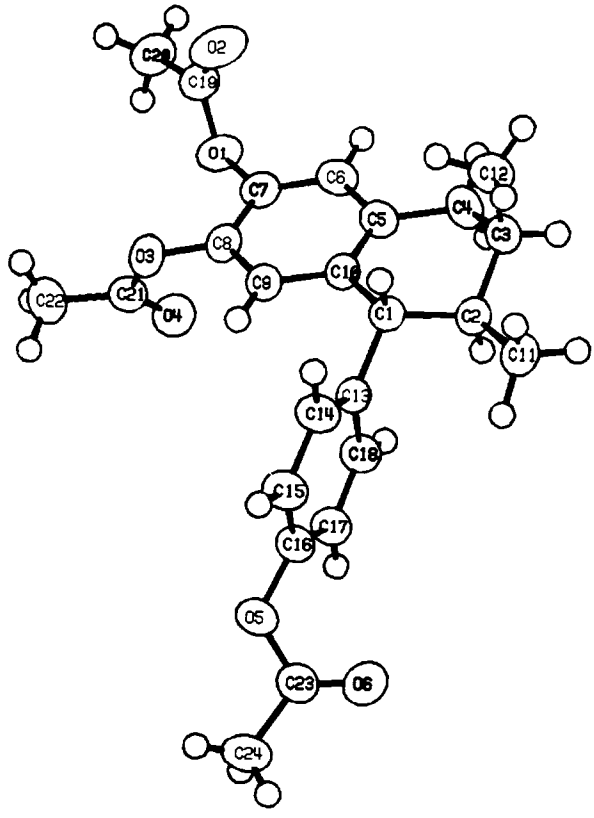


FIGURE 1. The molecular structure of 3′-demethoxynorisoguaiacin triacetate [2]

least squares, with nonhydrogen atoms refined anisotropically using the Enraf-Nonius SDP (6). Hydrogen atoms were located by difference maps and included as fixed contributions to the structure factors. Convergence was achieved with R=0.051. The absolute configuration was not determined.

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