Crystal and Molecular Structure of Dimethyl 3-Methoxy-4-isopropylpent-2-enedioate; A Synthetic Intermediate to the Espintanol

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In 1991 the leishmanicidal and trypanocidal monoterpene espintanol was isolated from the spruce *Oxandra espintana*.¹ Since then, there have appeared several syntheses to obtain this natural product.² In our working group we have undertaken the synthesis of such monoterpene. Here we wish to report the X-ray structure of an intermediate to the espintanol: the dimethyl E-3-methoxy-4-isopropylpent-2-enedioate, **1**. Data were collected on a Siemens P4 diffractometer. Crystallographic data and details of X-ray data collection and structure refinement as well are summarized in Table 1. The intensities were collected using nickel-filtered Cu K α radiation ($\lambda = 1.54178$ Å) at room temperature and were corrected for Lorentz and polarization effects.³ The structure was solved by direct methods⁴ and refined by full-matrix least-squares with anisotropic temperature factors for the non-hydrogen atoms. The structure solution and refinement include observed reflections with $F > 4.0\sigma(F)$ only.

Table 1 Crystallographic data for the dimethyl 3-methoxy-4-isopropyl-pent-2-enedioate

Formula: C ₁₁ H ₁₈ O ₅
Formula weight = 230.25
Crystal system: monoclinic
Space group: P2 ₁ /c
Z = 4
Crystal dimensions = 0.44 × 0.24 × 0.24 mm
a = 13.374(2) Å
b = 7.530(1) Å
c = 14.494(2) Å
$\beta = 114.31(1)^\circ$
V = 1330.2(3) Å ³
D _x = 1.150 g/cm ³
θ range = 1.50–56.74 Cu K α ($\lambda = 1.54178$ Å)
h k l range = 0 ≤ h ≤ 14, 0 ≤ k ≤ 8 and –15 ≤ l ≤ 14
$F(0\ 0\ 0) = 496$
$\mu = 0.758\text{ mm}^{-1}$ ($\lambda = 1.54178$ Å)
R = 6.35%
R _w = 15.97%
Goodness-of-fit = 1.046
Independent reflections = 1783 ($R_{\text{int}} = 3.03\%$)
$(\Delta\rho)_{\text{max}} = 0.206\text{ e}\text{Å}^{-3}$
$(\Delta\rho)_{\text{min}} = -0.232\text{ e}\text{Å}^{-3}$
Diffractometer: Siemens P4
Program system: Siemens XSCANS

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Table 2 Atomic coordinates ($\times 10^4$) and equivalent isotropic displacement coefficients ($\text{Å}^2 \times 10^3$)

	<i>x</i>	<i>y</i>	<i>z</i>	<i>U</i> _{eq}
O(1)	9196(3)	1440(4)	6286(2)	105(1)
O(2)	9139(3)	–1210(4)	5612(2)	102(1)
O(3)	6052(2)	2125(3)	3755(2)	69(1)
O(4)	6760(2)	6287(3)	3875(2)	82(1)
O(5)	8309(3)	4884(4)	4137(3)	100(1)
C(1)	8721(3)	386(5)	5642(3)	67(1)
C(2)	7648(3)	548(4)	4792(3)	61(1)
C(3)	7052(3)	2025(4)	4530(2)	53(1)
C(4)	7350(3)	3800(4)	5037(3)	55(1)
C(5)	7410(3)	5152(4)	4286(3)	60(1)
C(6)	6541(4)	4385(5)	5490(3)	76(1)
C(7)	6934(5)	6054(6)	6124(4)	105(2)
C(8)	6348(5)	2927(7)	6111(4)	121(2)
C(9)	10184(5)	–1591(8)	6404(4)	137(2)
C(10)	8489(6)	6058(7)	3431(5)	142(3)
C(11)	5547(4)	506(6)	3250(3)	88(1)

Equivalent isotropic *U* defined as one third of the trace of the orthogonalized *U*_{ij} tensor.

Table 3 Selected bond lengths and angles

Bond lengths (Å)			
O(1)–C(1)	1.190 (5)	O(2)–C(1)	1.333 (5)
O(2)–C(9)	1.426 (6)	O(3)–C(3)	1.349 (4)
O(3)–C(11)	1.439 (4)	O(4)–C(5)	1.190 (4)
O(5)–C(5)	1.321 (4)	O(5)–C(10)	1.445 (5)
C(1)–C(2)	1.462 (5)	C(2)–C(3)	1.329 (5)
C(3)–C(4)	1.498 (4)	C(4)–C(5)	1.516 (5)
C(4)–C(6)	1.543 (5)	C(6)–C(8)	1.508 (6)
C(6)–C(7)	1.517 (6)		
Bond angles (°)			
C(1)–O(2)–C(9)	116.1(4)	C(3)–O(3)–C(11)	118.2(3)
C(5)–O(5)–C(10)	116.8(4)	O(1)–C(1)–O(2)	122.1(4)
O(1)–C(1)–C(2)	128.8(4)	O(2)–C(1)–C(2)	109.1(4)
C(3)–C(2)–C(1)	125.2(3)	C(2)–C(3)–O(3)	123.9(3)
C(2)–C(3)–C(4)	126.8(3)	O(3)–C(3)–C(4)	109.3(3)
C(3)–C(4)–C(5)	109.2(3)	C(3)–C(4)–C(6)	111.8(3)
C(5)–C(4)–C(6)	111.6(3)	O(4)–C(5)–O(5)	123.6(4)
O(4)–C(5)–C(4)	126.7(3)	O(5)–C(5)–C(4)	109.6(3)
C(8)–C(6)–C(7)	110.0(4)	C(8)–C(6)–C(4)	111.6(3)
C(7)–C(6)–C(4)	111.5(3)

Fig. 1 Molecular structure of dimethyl 3-methoxy-4-isopropylpent-2-enedioate.

The hydrogen atoms were placed at their idealized positions and included in the structure factor calculation with fixed isotropic thermal parameters ($U = 0.08 \text{ \AA}^2$).

A diagram of the structure of the dimethyl 3-methoxy-4-isopropylpent-2-enedioate is shown in Fig. 1. The asymmetric unit and atomic numbering are shown in Fig. 2. The bond lengths and angles agree with the expected values. The stereochemistry of compound **1** at the double bond is E.

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Fig. 2 Structure of the dimethyl 3-methoxy-4-isopropylpent-2-enedioate showing the numbering scheme for the atoms.

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