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1,1′-(4-Methylbenzylidene)bis(5-oxopyrrolidine-2-carboxylic acid)

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Key indicators

Single-crystal X-ray study
T = 293 K
Mean σ(C–C) = 0.003 Å
R factor = 0.028
wR factor = 0.076
Data-to-parameter ratio = 8.2

For details of how these key indicators were automatically derived from the article, see http://journals.iucr.org/e.

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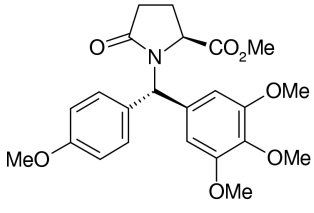
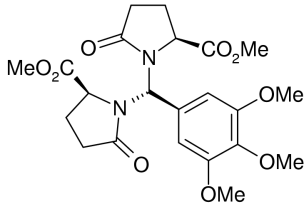
In the course of a study on pyrrolidinone-derived anticancer agents, the crystal structure of the title compound, 1,1′-(4-methylbenzylidene)bis(5-oxopyrrolidine-2-carboxylic acid), $C_{18}H_{20}N_2O_6$, was determined. In this compound, a π–π interaction brings the first carboxylic acid group above the aromatic ring, whereas the second carboxylic acid group is oriented above one of the pyrrolidine rings.

Comment

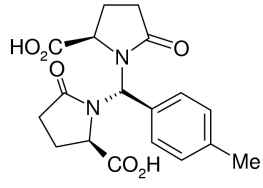
Azatoxin, an anticancer drug, is an inhibitor of both topoisomerase II and tubulin polymerization (Leteurtre *et al.*, 1995). Recently, the crystal structure of methyl *N*-[(4-methoxyphenyl)(3,4,5-trimethoxyphenyl)methyl]pyroglutamate, (I), an aryl derivative of a precursor of two azatoxin analogues, has been studied (Camus *et al.*, 2000). This aryl compound presents mild anticancer properties (Bourry *et al.*, 2001). During various attempts to obtain (I) stereoselectively, the reactivity of other reactants were tested and methyl 1-{[2-(methoxycarbonyl)-5-oxopyrrolidin-1-yl](3,4,5-trimethoxyphenyl)methyl}pyroglutamate, (II), was obtained. The spatial structure of the diester (II) was confirmed by an X-ray analysis of a rather similar compound, 1,1′-(4-methylbenzylidene)bis(5-oxopyrrolidine-2-carboxylic acid), (III).



(I)



(II)



(III)

In this compound, the sp^2 hybridization of N9 and N15 is confirmed [sum of bond angles around N9 and N15 is 359.7 (1) and 359.8 (1)° respectively]. Moreover, the torsion angle C19—N15—C8—N9 of 45.5 (2)° brings the C20-containing carboxylic acid function just above the second pyrrolidine ring. Furthermore, a π–π interaction orients the C14-containing carboxylic acid group just above the aromatic ring, imposing a torsion angle C13—N9—C8—C5 of 28.8 (2)°.

Experimental

Crystal data

$C_{18}H_{20}N_2O_6$	Cu $K\alpha$ radiation
M_r = 360.36	Cell parameters from 25 reflections
Orthorhombic, $P2_12_12_1$	θ = 38–42°
a = 9.077 (1) Å	μ = 0.89 mm^{-1}
b = 11.065 (1) Å	T = 293 (2) K
c = 17.106 (1) Å	Prism, colorless
V = 1718.1 (3) Å^3	0.40 × 0.30 × 0.20 mm
Z = 4	Crystal source: see text
D_x = 1.393 Mg m^{-3}	

Data collection

Enraf–Nonius CAD-4 diffractometer	R_{int} = 0.017
$\theta/2\theta$ scans	θ_{max} = 71.9°
Absorption correction: ψ scan (North *et al.*, 1968)	$h = -11 \rightarrow 11$
T_{min} = 0.718, T_{max} = 0.843	$k = 0 \rightarrow 13$
2767 measured reflections	$l = 0 \rightarrow 21$
2499 independent reflections	3 standard reflections
2443 reflections with $I > 2\sigma(I)$	every 200 reflections
	frequency: 60 min
	intensity decay: 2%

Refinement

Refinement on F^2	$w = 1/[\sigma^2(F_o^2) + (0.048P)^2 + 0.307P]$ where $P = (F_o^2 + 2F_c^2)/3$
$R[F^2 > 2\sigma(F^2)]$ = 0.028	$(\Delta/\sigma)_{max}$ = 0.002
$wR(F^2)$ = 0.076	$\Delta\rho_{max}$ = 0.15 e Å^{-3}
S = 1.03	$\Delta\rho_{min}$ = −0.15 e Å^{-3}
2499 reflections	Absolute structure: Flack (1983)
304 parameters	Flack parameter = 0.02 (19)
H atoms treated by a mixture of independent and constrained refinement	

The synthesis of (III) has been reported elsewhere (Bourry *et al.*, 2001). Crystals were obtained by slow evaporation of a methanol solution at room temperature.

Data collection: *CAD*-4 *EXPRESS* (Enraf–Nonius, 1992); cell refinement: *CAD*-4 *EXPRESS*; data reduction: *PLATON* (Spek, 2001); program(s) used to solve structure: *SIR*97 (Altomare *et al.*, 1999); program(s) used to refine structure: *SHELXL*97 (Sheldrick, 1997); molecular graphics: *PLATON* (Spek, 2001); software used to prepare material for publication: *SHELXL*97.

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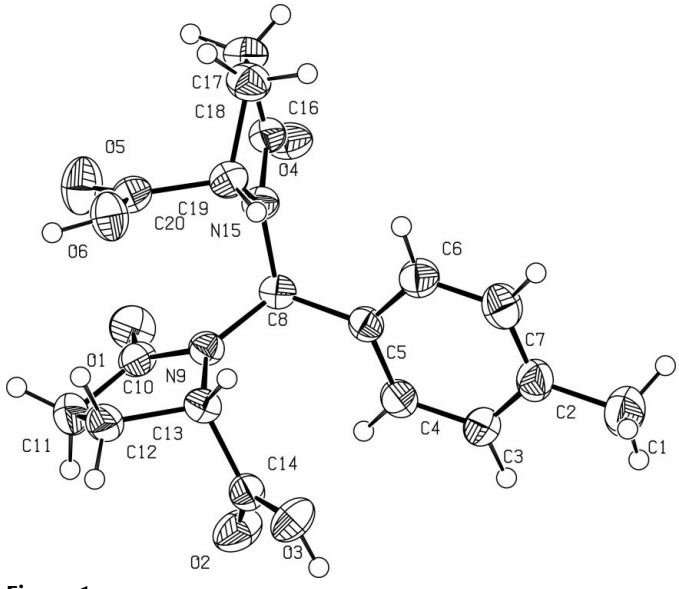

Figure 1
*ORTEP*II (Johnson, 1976) representation of compound (III) with ellipsoids at the 50% probability level.

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