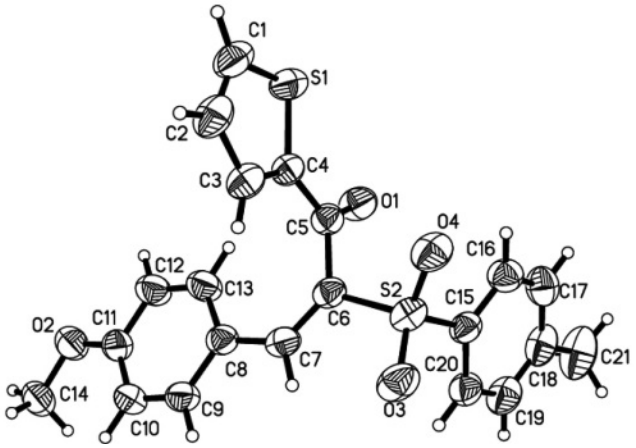
Crystal structure of (*E*)-3-(4-methoxyphenyl)-1-(thiophen-2-yl)-2-tosylprop-2-en-1-one, $C_{21}H_{18}O_4S_2$

Hatem A. Abdel-Aziz[I, II], Hazem A. Ghabbour[I] and Hoong-Kun Fun[*, I, III]

[I] Department of Pharmaceutical Chemistry, College of Pharmacy, King Saud University, P.O.Box 2457, Riaydh 11451, Saudi Arabia
[II] Department of Applied Organic Chemistry, National Research Center, Dokki, Cairo 12622, Egypt
[III] X-ray Crystallography Unit, School of Physics, Universiti Sains Malaysia, 11800, USM, Penang, Malaysia

Received September 06, 2014, accepted February 12, 2015, available online February 19, 2015, CCDC no. 1267/4255



Abstract

$C_{21}H_{18}O_4S_2$, orthorhombic, *Pbca* (no. 61), a = 8.2038(3) Å, b = 19.8810(7) Å, c = 24.0661(8) Å, V = 3925.2 Å^3, Z = 8, $R_{gt}(F)$ = 0.0490, $wR_{ref}(F^2)$ = 0.1426, T = 293 K.

Table 1. Data collection and handling.

Crystal:	yellow plates, size 0.29×0.43×0.49 mm
Wavelength:	Cu K_α radiation (1.54178 Å)
μ:	26.61 cm^{-1}
Diffractometer, scan mode:	Bruker APEX-II CCD, φ and ω
$2\theta_{max}$:	140.16°
$N(hkl)_{measured}$, $N(hkl)_{unique}$:	25778, 3672
Criterion for I_{obs}, $N(hkl)_{gt}$:	$I_{obs} > 2\ \sigma(I_{obs})$, 2511
$N(param)_{refined}$:	246
Programs:	SHELX [17]

Source of material

1-(Thiophen-2-yl)-2-tosylethan-1-one was prepared by the reaction of 2-bromo-1-(thiophen-2-yl)ethan-1-one with sodium 4-tolylsulfinate. Next, the reaction of 1-(thiophen-2-yl)-2-tosylethan-1-one with 4-anisaldehyde, in the presence of piperidine, afforded the title compound in 77% yield. The IR revealed the absorption band of a carbonyl function at 1665 cm^{-1} while its ^{1}HNMR exhibited the signal of –CH= group at δ = 8.01 in addition to the singlet signals of methyl and methoxy protons at δ = 2.40 and 3.74, respectively.

Discussion

There are great interests in the chemistry and biological activity of thiophene derivatives as the thiophene moiety is an important domain in a large number of biologically active structures [1–4], and it is also a well-known isostere for benzene ring [5]. On the other hand, sulfones received a special interest in organic chemistry for their ambivalent nature and due to their versatile reactivity in organic synthesis [6, 7]. In addition, β-keto sulfones have gained wide applications as starting materials in the synthesis of several important compounds [8–10]. In continuation of our interests in the chemistry and biologically activity of sulfone and sulfonamide derivatives [11–16], we report herein the synthesis and X-ray single crystal analyses of the title compound. Fortunately, we have succeeded to get single crystals of the title compound and were able to assign its (*E*)-configuration. The crystal structure contains one molecule in the asymmetric unit. The *E* isomer of the title compound is the kinetically favored candidate. The double bond of C6=C7 is characterized by the distance of 1.334 (4) Å. The molecules packing in the crystal structure is stabilized by two weak intermolecular interactions, with O3 and O4 as hydrogen bond acceptors and C3 and C19 as hydrogen bond donor. The distance of the interactions between H3A···O3 is 2.4400(11) Å, H19A···O4 is 2.4700(9) Å and the angles C3–H3A···O3 is 123.00(4)°, C19–H19A···O4 is 166.00(7)°.

Table 2. Atomic coordinates and displacement parameters (in Å^2).

Atom	Site	x	y	z	U_{iso}
H(1A)	8*c*	–0.4474	0.8137	0.3015	0.116
H(2A)	8*c*	–0.3956	0.7312	0.3707	0.112
H(3A)	8*c*	–0.1147	0.7322	0.4027	0.091
H(7A)	8*c*	0.2997	0.7129	0.4372	0.086
H(9A)	8*c*	0.3758	0.6072	0.4046	0.097
H(10A)	8*c*	0.4322	0.5319	0.3351	0.102
H(12A)	8*c*	0.2472	0.6601	0.2242	0.110
H(13A)	8*c*	0.1919	0.7351	0.2933	0.104
H(14A)	8*c*	0.4888	0.4679	0.2004	0.150
H(14B)	8*c*	0.4069	0.4586	0.2587	0.150
H(14C)	8*c*	0.5699	0.4992	0.2533	0.150
H(16A)	8*c*	0.2417	0.9697	0.4277	0.100
H(17A)	8*c*	0.4621	1.0366	0.4084	0.111
H(19A)	8*c*	0.7613	0.8911	0.4595	0.115
H(20A)	8*c*	0.5413	0.8237	0.4790	0.097
H(21A)	8*c*	0.8580	1.0147	0.4465	0.209
H(21B)	8*c*	0.7449	1.0603	0.4099	0.209
H(21C)	8*c*	0.8328	0.9981	0.3834	0.209

* Correspondence author (e-mail: hfun.c@ksu.edu.sa)

Table 3. Atomic coordinates and displacement parameters (in Å^2).

Atom	Site	x	y	z	U_{11}	U_{22}	U_{33}	U_{12}	U_{13}	U_{23}
S(1)	8*c*	–0.1777(1)	0.85256(5)	0.30177(3)	0.0827(6)	0.0991(6)	0.0904(5)	0.0057(4)	–0.0240(4)	0.0092(4)
S(2)	8*c*	0.20390(9)	0.83681(4)	0.46622(3)	0.0654(5)	0.0935(5)	0.0645(4)	–0.0069(3)	–0.0043(3)	0.0039(3)
O(1)	8*c*	0.1786(2)	0.8680(1)	0.33102(9)	0.085(1)	0.095(2)	0.091(1)	–0.020(1)	–0.012(1)	0.030(1)
O(2)	8*c*	0.3783(3)	0.5487(1)	0.22744(9)	0.110(2)	0.077(1)	0.098(2)	0.008(1)	–0.004(1)	0.001(1)
O(3)	8*c*	0.2435(3)	0.7918(1)	0.51064(8)	0.111(2)	0.115(2)	0.067(1)	–0.018(1)	–0.016(1)	0.019(1)
O(4)	8*c*	0.0591(2)	0.8768(1)	0.46992(8)	0.057(1)	0.123(2)	0.093(1)	0.004(1)	0.0039(9)	–0.015(1)
C(1)	8*c*	–0.3460(4)	0.8072(2)	0.3180(2)	0.066(2)	0.125(3)	0.101(2)	0.003(2)	–0.017(2)	–0.021(2)
C(2)	8*c*	–0.3168(4)	0.7606(2)	0.3572(1)	0.061(2)	0.122(3)	0.096(2)	–0.017(2)	0.008(1)	–0.016(2)
C(3)	8*c*	–0.1554(3)	0.7610(2)	0.3757(1)	0.062(2)	0.098(2)	0.068(2)	–0.006(1)	0.003(1)	0.000(1)
C(4)	8*c*	–0.0643(3)	0.8089(1)	0.34914(9)	0.061(2)	0.074(2)	0.057(1)	–0.001(1)	–0.002(1)	–0.001(1)
C(5)	8*c*	0.1065(3)	0.8255(1)	0.3579(1)	0.070(2)	0.070(2)	0.061(1)	–0.003(1)	–0.002(1)	0.007(1)
C(6)	8*c*	0.1918(3)	0.7887(1)	0.4042(1)	0.058(2)	0.074(2)	0.066(2)	–0.009(1)	–0.006(1)	0.008(1)
C(7)	8*c*	0.2590(3)	0.7276(1)	0.4033(1)	0.063(2)	0.081(2)	0.071(2)	–0.008(1)	–0.010(1)	0.016(1)
C(8)	8*c*	0.2786(3)	0.6804(1)	0.3578(1)	0.064(2)	0.070(2)	0.073(2)	–0.006(1)	–0.007(1)	0.011(1)
C(9)	8*c*	0.3500(4)	0.6185(2)	0.3682(1)	0.081(2)	0.077(2)	0.083(2)	–0.002(1)	–0.016(1)	0.018(2)
C(10)	8*c*	0.3844(4)	0.5730(2)	0.3266(1)	0.089(2)	0.066(2)	0.101(2)	0.006(2)	–0.015(2)	0.011(2)
C(11)	8*c*	0.3475(3)	0.5889(1)	0.2724(1)	0.074(2)	0.070(2)	0.086(2)	–0.006(1)	–0.004(1)	0.008(2)
C(12)	8*c*	0.2743(4)	0.6496(2)	0.2607(1)	0.112(3)	0.083(2)	0.079(2)	0.014(2)	–0.010(2)	0.012(2)
C(13)	8*c*	0.2409(4)	0.6943(2)	0.3022(1)	0.102(2)	0.075(2)	0.082(2)	0.014(2)	–0.007(2)	0.012(2)
C(14)	8*c*	0.4682(4)	0.4888(2)	0.2356(2)	0.108(3)	0.073(2)	0.120(3)	0.006(2)	–0.001(2)	0.005(2)
C(15)	8*c*	0.3704(3)	0.8902(1)	0.4547(1)	0.057(2)	0.080(2)	0.069(2)	0.002(1)	–0.006(1)	–0.008(1)
C(16)	8*c*	0.3467(4)	0.9538(2)	0.4339(1)	0.070(2)	0.088(2)	0.091(2)	0.003(2)	–0.003(1)	0.002(2)
C(17)	8*c*	0.4785(5)	0.9935(2)	0.4224(1)	0.104(3)	0.079(2)	0.095(2)	–0.013(2)	0.011(2)	–0.002(2)
C(18)	8*c*	0.6357(4)	0.9709(2)	0.4311(1)	0.075(2)	0.114(3)	0.086(2)	–0.023(2)	0.015(2)	–0.028(2)
C(19)	8*c*	0.6565(4)	0.9070(2)	0.4528(1)	0.059(2)	0.121(3)	0.106(2)	0.003(2)	–0.001(2)	–0.030(2)
C(20)	8*c*	0.5255(4)	0.8666(2)	0.4646(1)	0.064(2)	0.086(2)	0.092(2)	0.004(2)	–0.009(1)	–0.012(2)
C(21)	8*c*	0.7814(5)	1.0151(2)	0.4164(2)	0.113(3)	0.168(4)	0.138(4)	–0.066(3)	0.038(2)	–0.037(3)

Acknowledgments. The authors would like to extend their sincere appreciation to the Deanship of Scientific Research at King Saud University for its funding of this research through the Research Group Project no. RGP-VPP-321.

References

1. Lu, X.; Wan, B.; Franzblau, S. G.; You, Q.: Design, synthesis and anti-tubercular evaluation of new 2-acylated and 2-alkylated amino-5-(4-(benzyloxy)phenyl)thiophene-3-carboxylic acid derivatives. Eur. J. Med. Chem. **46** (2011) 3551–3563.
2. Bonini, C.; Chiummiento, L.; De Bonis, M.; Funicello, M.; Lupattelli, P.; Suanno, G.; Berti, F.; Campaner, P.: Synthesis, biological activity and modelling studies of two novel anti HIV PR inhibitors with a thiophene containing hydroxyethylamino core. Tetrahedron **61** (2005) 6580–6589.
3. Alomar, K.; Landreau, A.; Allain, M.; Bouet, G.; Larche, G.: Synthesis, structure and antifungal activity of thiophene-2,3-dicarboxaldehyde bis(thiosemicarbazone) and nickel(II), copper(II) and cadmium(II) complexes: unsymmetrical coordination mode of nickel complex. J. Inorg. Biochem. **126** (2013) 76–83.
4. Fadda, A. A.; Abdel-Latif, E.; El-Mekawy, R. E.: Synthesis and molluscicidal activity of some new thiophene, thiadiazole and pyrazole derivatives. Eur. J. Med. Chem. **44** (2009) 1250–1256.
5. Corral, C.; Lissavetzky, J.; Manzanares, I.; Darias, V.; Expósito-Orta, M. A.; Conde, J. A. M.; Sánchez-Mateo, C. C.: Synthesis and preliminary pharmacological evaluation of thiophene analogues of viloxazine as potential antidepressant drugs. Bioorg. Med. Chem. **7** (1999) 1349–1359.
6. Markitanov, Y. M.; Timoshenko, V. M.; Shermolovich, Y. G.: β-Keto sulfones: preparation and application in organic synthesis. J. Sulfur Chem. **35** (2014) 188–236.
7. Patai, S.; Rappoport, Z.; Stirling, C.: The chemistry of sulphones and sulphoxides (1988) John Wiley & Sons, Chichester, ISBN 0–471–91588–2.
8. Katritzky, A. R.; Abdel-Fattah, A. A.; Wang, M.: Efficient conversion of sulfones into beta-keto sulfones by N-acylbenzotriazoles. J. Org. Chem. **68** (2003) 1443–1446.
9. Baldwin, J. E.; Adlington, R. M.; Crouch, N. P.; Hill, R. L.; Laffey, T. G.: An expedient synthesis of trisubstituted allenes. Tetrahedron Lett. **36** (1995) 7925–7928.
10 Xiang, J.; Ipek, M.; Suri, V.; Tam, M.; Xing, Y.; Huang, N.; Zhang, Y.; Tobin, J.; Mansour, T. S.; McKew, J.: beta-Keto sulfones as inhibitors of 11beta-hydroxysteroid dehydrogenase type I and the mechanism of action. Bioorg. Med. Chem. **15** (2007) 4396–4405.
11. Abdel-Aziz, H. A.; Bari, A.; Weng Ng, S.: 3-(5-Phenyl-4-phenylsulfonyl-1-*p*-tolyl-1*H*-pyrazol-3-yl)-1,2-dihydroquinoxaline. Acta Crystallogr. **E67** (2011) o695.
12. Abdel-Aziz, H. A.; Al-Rashood, K. A.; Weng Ng, S.; Tiekink, E. R. T.: Ethyl 1-(4-methyl-phenyl)-5-phenyl-4-phenyl-sulfon-yl-1*H*-pyrazole-3-carboxylate. Acta Crystallogr. **E67** (2011) o2623–o2624.
13. Abdel-Aziz, H. A.; Al-Rashood, K. A.; Ghabbour, H. A.; Fun, H.-K.; Chia, T. S.: 1-(4-Methylphenyl)-2-(phenylsulfonyl)-ethanone. Acta Crystallogr. **E68** (2012) o1033.
14. Alafeefy, A. M.; Abdel-Aziz, H. A.; Vullo, D.; Al-Tamimi, A.-M. S.; Al-Jaber, N. A.; Capasso, C.; Supuran, C. T.: Inhibition of carbonic anhydrases from the extremophilic bacteria *Sulfurihydrogenibium yellostonense* (SspCA) and *S. azorense* (SazCA) with a new series of sulfonamides incorporating aroylhydrazone-, [1,2,4]triazolo[3,4-*b*]-[1,3,4]thiadiazinyl- or 2-(cyanophenylmethylene)-1,3,4-thiadiazol-3(2*H*)-yl moieties. Bioorg. Med. Chem. **22** (2014) 141–147.
15 Alafeefy, A. M.; Isik, S.; Al-Jaber, N. A.; Vullo, D.; Abdel-Aziz, H. A.; Ashour, A. E.; Awaad, A. S.; Capasso, C.; Supuran, C. T.: Carbonic anhydrase inhibitors. Benzenesulfonamides incorporating cyanoacrylamide moieties strongly inhibit *Saccharomyces cerevisiae* β-carbonic anhydrase. Bioorg. Med. Chem. Lett. **23** (2013) 3570–3575.
16. Alafeefy, A. M.; Isik, S.; Abdel-Aziz, H. A.; Ashour, A. E.; Vullo, D.; Al-Jaber, N. A.; Supuran, C. T.: Carbonic anhydrase inhibitors: Benzenesulfonamides incorporating cyanoacrylamide moieties are low nanomolar/subnanomolar inhibitors of the tumor-associated isoforms IX and XII. Bioorg. Med. Chem. **21** (2013) 1396–1403.
17. Sheldrick, G. M.: A short history of SHELX. Acta Crystallogr. **A64** (2008) 112–122.