

SYNTHESES OF VINYLOGOUS 4H-PYRONES FROM 2,6-DIMETHYL-4H-PYRAN-4-THIONE
AND ARENYL BROMOMETHYL KETONES

Katsuo Ohkata, Masao Imagawa, and Kin-ya Akiba*

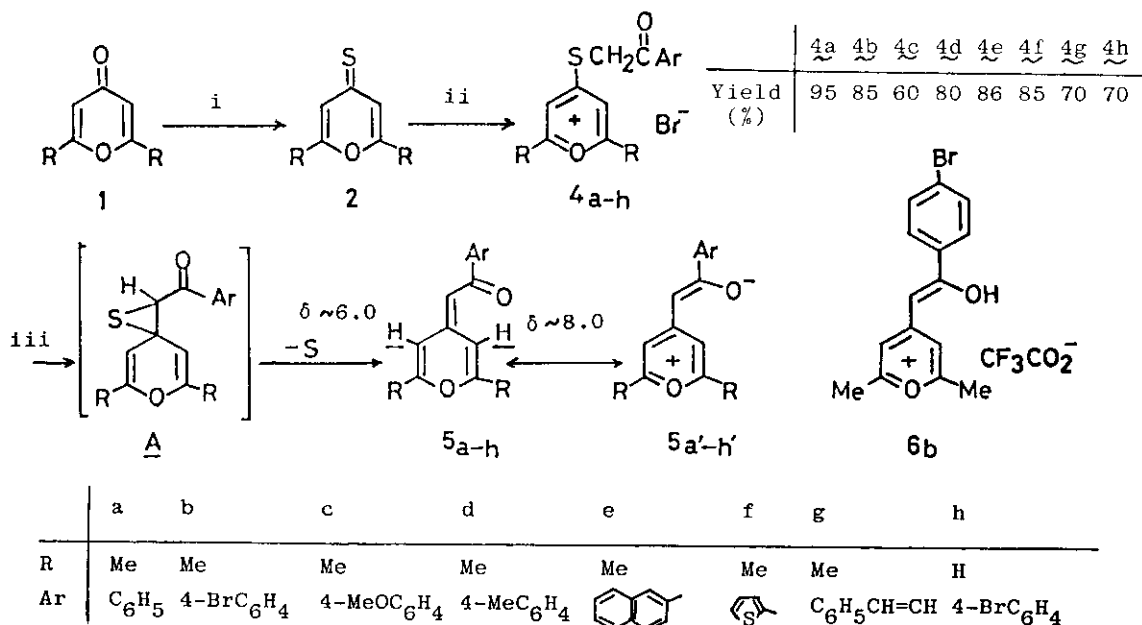
Department of Chemistry, Faculty of Science, Hiroshima University
Higashisenda-machi, Nakaku, Hiroshima 730, Japan

Abstract - 2,6-Dimethyl-4H-pyran-4-ylideneacetophenones (5)
were prepared by desulfurization of mercaptopyrylium salts (4)
with diazabicyclo[5.4.0]undecene (DBU) in moderate yield.
The ^1H NMR spectra in CDCl_3 solution of 5 show the exclusive
preference for s-cis conformation at the enone site.

Although some synthetic methods for vinylogous 4H-pyrones have been devised,¹
there are inherent limitations in each methodology. In this report, we wish to
describe the synthesis of 4H-pyran-4-ylideneacetophenone derivatives from easily
available 2,6-dimethyl-4H-pyrone (1; R = Me). Thionation of 1 with phosphorus
pentasulfide in the presence of NaHCO_3 in tetrahydrofuran solution afforded
4-thione derivative (2) in 70% yield. 4H-pyran-4-thione (2'; R = H) also was
obtained in 70% yield by means of the same method. Treatment of 2 with arenyl
bromomethyl ketones (3) in acetone solution under reflux gave the corresponding
4-mercaptopyrylium derivatives (4a-h) as precipitates in 60-95% yield,
respectively.

Typical conditions for sulfide contraction and desulfurization by means of base
and phosphine were applied to 4a according to the literature² but the desired
product (5a) was obtained in just a low yield (20%). On the other hand, treatment
of 4a with DBU without phosphine furnished 5a in 37% yield. In order to select a
better reagent for preparation of vinylogous 4H-pyrones, various bases were
examined. The best result was obtained when DBU was used as a base without any
phosphine (Table I). It is considered that sulfide contraction with base results
in the formation of spiro-episulfide derivative (A) and is followed by

desulfurization to give the product (5a-h), which is a zwitter-ionic species. A typical reaction utilizing DBU is described. To a stirred suspension of 4-(p-bromophenacyl)mercapto-2,6-dimethylpyrylium bromide (4b: 209 mg, 0.5 mmol) in acetonitrile (10 ml) was added dropwise at -15 °C a solution of DBU (80 mg, 0.5 mmol) in the same solvent (5 ml). The mixture was stirred at the same temperature for 1 h. The homogeneous solution was concentrated and the residue was purified by preparative TLC on silica gel (ethyl acetate-hexane; 1:3) to give 87 mg of 2,6-dimethyl-4-p-bromophenacylidene-4H-pyran (5b: 57%: mp 88-90 °C from hexane-ether).³ Table II shows typical yields for the preparation of 5a-h. ¹H NMR spectral data are shown in Table III. In ¹H NMR spectra, one of β -protons of pyrone ring appears at very low field (δ ca. 8.0) as compared with the counterpart (δ ca. 6.0). The downfield shift of one of β -protons in 5a-h is ascribed to deshielding anisotropies due to the exclusive existence of the s-cis conformation which minimizes the steric interactions between β -H and the benzoyl group, as has previously been described.^{1b,4} The distinct two peaks at δ 5.92 and δ 7.95 for 5b coalesced into a single peak at δ 7.2 by addition of CF₃CO₂H to the solution, showing the formation of pyrylium salt (6b).



Reagents and conditions: (i) P₄S₁₀, NaHCO₃ in THF ; (ii) BrCH₂COAr in Me₂CO ; (iii) DBU in CH₃CN.

Table I.

Reaction Conditions for Desulfurization of 4a,b in Acetonitrile at -15 °C

compd	Ar	reagents (1 equiv)	yield (%)
<u>4a</u>	C ₆ H ₅	DBU/Ph ₃ P	22
		DBU/n-Bu ₃ P	20
		DBU	37
<u>4b</u>	4-BrC ₆ H ₄	Et ₃ N	0
		Dabco ^a	0
		NaH	24
		PMP ^b	27
		DBU	57

^a, diazabicyclo[2.2.2]octane.^b, 1,2,2,6,6-pentamethylpiperidine.

Table II.

Preparation of 4H-Pyrone Vinylogues (5a-h) by Desulfurization of 4a-h

compd	R	Ar	yield (%)
<u>5a</u>	Me	C ₆ H ₅	37
<u>5b</u>	Me	4-BrC ₆ H ₄	57
<u>5c</u>	Me	4-MeOC ₆ H ₄	22
<u>5d</u>	Me	4-MeC ₆ H ₄	36
<u>5e</u>	Me	2-C ₁₀ H ₇	51
<u>5f</u>	Me	2-C ₄ H ₃ S ^b	42
<u>5g</u>	Me	C ₆ H ₅ CH=CH	8
<u>5h</u>	H	4-BrC ₆ H ₄	11

^a, 2-naphthyl. ^b, 2-thiophenyl.Table III. ¹H NMR and Mass Spectra of 4H-pyran-4-ylidene Derivatives (5a-h)

compd	Mass (m/z)	¹ H NMR (δ, CDCl ₃)				
		methyl		vinyl		aromatic
<u>5a</u>	226(M ⁺)	2.11(d) ^b	2.16(d) ^a	5.91(q) ^b	6.09(s)	7.37-7.44(m, 3H)
	149(base)			7.95(q) ^a		7.84-7.95(m, 2H)
<u>5b</u>	305(M ⁺)	2.13(d) ^a	2.17(d) ^b	5.92(q) ^a	6.01(s)	7.51, 7.77(ABq, 4H) ^e
	149(base)			7.95(q) ^b		
<u>5c</u>	256(M ⁺)	2.11(d) ^a	2.15(d) ^b	5.90(q) ^a	6.07(s)	6.90, 7.89(ABq, 4H) ^f
	149(base)	3.84(s)		7.92(q) ^b		
<u>5d</u>	240(M ⁺)	2.10(d) ^b	2.15(d) ^b	5.89(q) ^b	6.08(s)	7.20, 7.81(ABq, 4H) ^d
	149(base)	2.37(s)		7.95(q) ^b		
<u>5e</u>	276(M ⁺)	2.10(s)	2.15(s)	5.94(s)	6.24(s)	7.43-7.99(m, 7H)
	149(base)			8.38(s)		
<u>5f</u>	232(M ⁺)	2.12(s)	2.19(s)	5.90(s)	5.97(s)	7.05(dd, 1H) ^k
	149(base)			7.91(s)		7.46(dd, 1H) ⁱ 7.59(dd, 1H) ^h
<u>5g</u>	252(M ⁺)	2.13(s)	2.16(s)	5.59(s)	5.86(s)	7.23-7.62(m, 7H)
	140(base)			7.94(s)		
<u>5h</u>	277(M ⁺)	---	---	6.16(dd) ^j	6.15(s)	7.52, 7.74(ABq, 4H) ^g
	121(base)			8.07(dd) ^j	7.16(d, 2H) ^c	

^a, J=0.7 Hz. ^b, J=0.9 Hz. ^c, J=6.2 Hz. ^d, J=8.1 Hz. ^e, J=8.8 Hz. ^f, J=9.0 Hz. ^g, J=13 Hz. ^h, J=1.1 and 3.7 Hz. ⁱ, 1.1 and 4.9 Hz. ^j, J=2.3 and 5.4 Hz. ^k, J=3.7 and 4.9 Hz.

ACKNOWLEDGEMENT

The authors are indebted partially to a Grant-in-Aid for Special Project Research (No. 61111004), Ministry of Education, Science and Culture of Japanese Government.

REFERENCES AND NOTES

1. (a) A. T. Balaban, P. T. Frangopol, A. R. Katritzky, and C. D. Nenitzescu, J. Chem. Soc., 3889 (1962). (b) E. T. Østensen and K. Undheim, Acta. Chem. Scand., 27, 2184 (1973). (c) J. A. VanAllan, G. A. Reynolds, and D. P. Maier, J. Org. Chem. 33, 4418 (1968). (d) I. Belsky, H. Dodiuk, and Y. Shvo, J. Org. Chem., 39, 989 (1974). (e) Y. Suzuki, T. Toda, and T. Mukai, Heterocycles, 4, 739 (1976). (f) A. T. Balaban, Tetrahedron Lett., 599 (1978).
2. M. R. P. Dubs, E. Götschi, and A. Eschenmoser, Helv. Chim. Acta, 54, 710 (1971).
3. Elemental analysis and spectral data for 5b were fully compatible with the given assignment.
4. A. T. Balaban, M. Fahmy, M. D. Gheorghiu, and V. Wray, Liebigs Ann. Chem., 1807 (1983). A. T. Balaban, V. Wray, N. G. Furmanova, V. I. Minkin, L. S. Minkina, Y. E. Czernysch, and G. S. Borodkin, Liebigs Ann. Chem., 1587 (1985).

Received, 25th June, 1986