

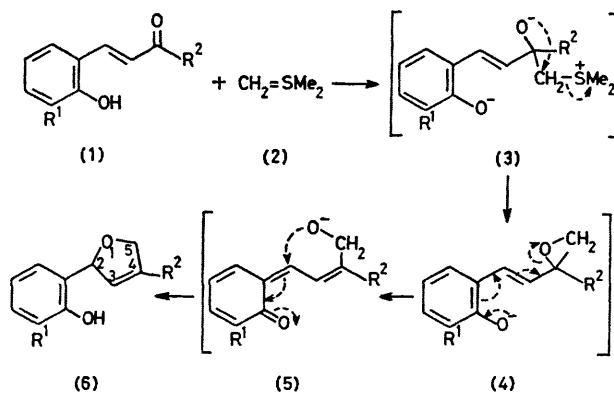
## Synthesis of 2-(*o*-Hydroxyphenyl)- and 2-(*p*-Hydroxyphenyl)-2,5-dihydrofurans from *o*- and *p*-Hydroxybenzylidene Ketones and Dimethylsulphonium Methylide

By PIERFRANCESCO BRAVO and CALIMERO TICOZZI

(Centro del C.N.R. per lo Studio delle Sostanze Organiche Naturali, Istituto di Chimica del Politecnico, 20133 Milano, Italy)

**Summary** Dimethylsulphonium methylide reacts smoothly with *o*- and *p*-hydroxybenzylidene ketones giving moderate to high yields of 2-(*o*-hydroxyphenyl)- and 2-(*p*-hydroxyphenyl)-2,5-dihydrofurans, respectively; the easy formation of *o*- or *p*-quinone methide intermediates accounts for the unusual course of the methylene transfer reaction.

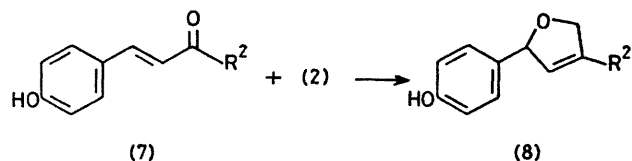
We have previously reported that by means of a ring-forming reaction induced by sulphonium ylides, open chain compounds such as 2-(*o*-hydroxyphenyl)alkyl ketones may be cyclized to give 3-hydroxy-2,3,4,5-tetrahydro-1-benzo-oxepins.<sup>1</sup> We have now found that the *o*-hydroxybenzylidene ketones (1) react with dimethylsulphonium methylide to give the 2-(*o*-hydroxyphenyl)2,5-dihydrofurans (6). This is the first case where  $\alpha\beta$ -unsaturated ketones give dihydrofurans instead of the expected  $\alpha\beta$ -unsaturated epoxides.<sup>2</sup> This reaction course can be explained by the mechanism in the Scheme. In intermediate (4) the epoxide



SCHEME

ring and the phenoxy anion are interconnected by a system of mobile electrons. Owing to a 'push-pull' phenomenon (at one end the phenoxy anion pumps electrons into the

system, while at the other end the epoxide ring tends to open and receives electrons on the oxygen), (4) is converted into the quinone methide intermediate (5). In the intermediate (5) the alkoxide group and the electrophilic end of the quinone methide are in a favourable position to interact, thus giving rise to dihydrofuran ring closure and simultaneous reformation of the aromatic system.† As expected *p*-hydroxy- (7) (but not *m*-hydroxy)benzylidene ketones gave the corresponding 2-(*p*-hydroxyphenyl)-2,5-dihydrofurans (8).



All reactions between hydroxybenzylidene ketones and dimethylsulphonium methylide were carried out in dimethyl sulphoxide-tetrahydrofuran mixtures at  $-5$  to  $-10$  °C using an excess of ylide. Yields and m.p.s of the new compounds (6) and (8) are reported in the Table.

The structures of (6) and (8) (it should be noted that the starting ketone oxygen is bound to a different carbon atom in the final product) were deduced mainly from  $^1\text{H}$  and  $^{13}\text{C}$  n.m.r. spectra, *e.g.*, the  $^1\text{H}$  n.m.r. spectrum of (6a) consists of four very complicated signals at  $\delta$  1.75 (Me), 4.62 ( $\text{CH}_2\text{O}$ ), 5.62 ( $-\text{CH}=\text{}$ ), and 6.08 ( $=\text{C}-\text{CH}-\text{O}-$ ), respectively.

† The possibility of forming a seven-membered ring from the intermediate (3), by dimethyl sulphide displacement due to the phenoxy anion, is prevented by the *trans* arrangement of the double bond.

<sup>1</sup> P. Bravo, C. Ticozzi, and D. Maggi, *J.C.S. Chem. Comm.*, 1976, 798.

<sup>2</sup> B. M. Trost and L. S. Melvin, 'Sulfur Ylides,' Academic Press, New York, 1975, p. 37.

TABLE<sup>a</sup>

Compound	R <sup>1</sup>	R <sup>2</sup>	Yield/%	M.p./°C
(6a)	H	Me	71	65—66
(6b)	OMe	Me	43	70—72
(6c)	H	Ph	68	108—109
(6d)	OMe	<i>p</i> -OMeC <sub>6</sub> H <sub>4</sub>	60	101—103
(8a)	—	Me	87 <sup>b</sup>	107—108
(8b)	—	Ph	91 <sup>b</sup>	144—145

<sup>a</sup> Satisfactory analyses were obtained for all new compounds.

<sup>b</sup> Depending on the ylide to substrate ratio and the conditions used the compound was contaminated by 5—10% of the corresponding methyl ether, arising from methylation of the *para*-phenolic oxygen. Overall yields are reported.

All seven protons are coupled to each other with direct, allylic or homoallylic coupling constants which were assigned by cross decoupling experiments. The oxygen atom is bound to both the benzylic carbon and the methylene group, which is confirmed by the chemical shifts of 5-H ( $\delta$  5.62), and both C-5 ( $\delta$  77.85 p.p.m.) and C-2 ( $\delta$  87.14 p.p.m.), thus ruling out the alternative formulation 3-(*o*-hydroxyphenyl)-5-methyl-2,5-dihydrofuran; such a compound would have been formed *via* ylide methylene insertion between C-1 and the oxygen of the  $-\text{CH}=\text{CH}-\text{CO}-$  system.

(Received, 22nd January 1979; Com. 062.)