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PHENOLS FROM PYRYLIUM SALTS

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Abstract - Treatment of pyrylium salts 1 and 2 with dimethylsulfonium methylide yields phenols which appear to arise from an arene oxide.

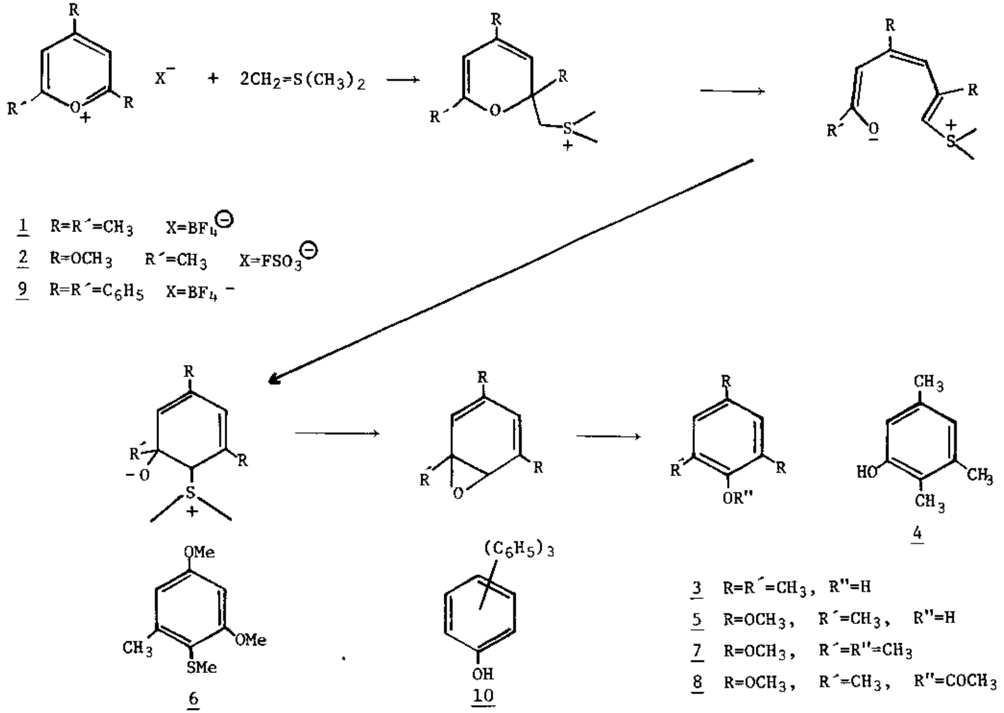
As part of a program to develop general techniques for the synthesis of cyclic epoxides, we envisaged that the reaction of pyrylium salts with sulfur ylides would provide ω-keto-ylides.[1] These ω-keto-ylides could then undergo ring closure to give arene oxides. We wish to report that pyrylium salt 1 or 2 affords phenols 3 and 4 or 5 and 6, respectively (Scheme I).

The nucleophilic reactions of pyrylium salts have been examined in detail,[2] including the treatment of 2 and 9 with phosphorous ylides to provide benzene derivatives[3] and the conversion of 9 into 2-(α-furyl)-acrylophenones with phenacyl phenyl methyl sulfonium ylides.[4] We felt this furan forming reaction, which seems anomolous with respect to other pyrylium salt chemistry, might require either highly stabilized ylides or 2,4,6-triphenyl pyrylium salts and therefore other sulfur ylides might afford different products.

Treatment of the pyrylium salt 1 with dimethyl sulfonium methylide at -78° C for 2 h and at 0° C for 1 h followed by aqueous acid work-up yields 3 (52%) and 4 (33%). Similarly, salt 2 provides 5 (32%), 6 (48%), and 4-methoxy-6-methyl-2-pyrone (20%). This pyrone arises from nucleophilic demethylation of 2. Phenols 3 and 4 were identified by comparison with authentic samples. The structures of compounds 5 and 6 were assigned by the usual spectral methods. The aromatic protons of 5 have the same chemical shift as the corresponding methyl ether 7 or acetate 8, suggesting these hydrogens are meta to the phenol. Treatment of pyrylium salt 9 under similar conditions provides a mixture of triphenyl phenols 10, the composition of which has not been rigorously established. If this mixture contains furans, they are present in less than 10% yield. Finally, treatment of 1 with dimethylsulfoxonium methylide[5a] at ambient temperature for 2 h and subsequent acid work-up also affords 3 and 4, albeit in somewhat lower yields.

The mechanism we currently favor for this transformation is presented in Scheme I. Addition of the ylide to the most electrophilic site of the pyrylium salt, followed by base-catalyzed ring opening and ring closure would yield an arene oxide. Rearrangement of this arene oxide could give 3 and 4 or 5. Compound 6 could arise by dehydration and de-S-methylation of the betaine precursor to this arene oxide. Several attempts to isolate 2,4,6-trimethyloxepin, the proposed precursor to 3 and 4, have been unsuccessful. The use of aqueous work-up, immediate chromatography on basic alumina, or

Scheme I



1 $R{=}R'{=}CH_3$ $X{=}BF_4^{\ominus}$

2 $R{=}OCH_3$ $R'{=}CH_3$ $X{=}FSO_3^{\ominus}$

9 $R{=}R'{=}C_6H_5$ $X{=}BF_4^{\ -}$

3 $R{=}R'{=}CH_3$, $R''{=}H$

5 $R{=}OCH_3$, $R'{=}CH_3$, $R''{=}H$

7 $R{=}OCH_3$, $R'{=}R''{=}CH_3$

8 $R{=}OCH_3$, $R'{=}CH_3$, $R''{=}COCH_3$

evaporative distillation affords diminished amounts of **3** and **4** accompanied by numerous other products. Analysis of the crude mixture by glc or tlc on basic alumina indicates that **3** and **4** are present prior to any work-up. We have been unable to trap the putative oxepin with maleic anhydride or 1-phenyl-1,3,4-triazene-2,5-dione. 2,4,6-Trimethyloxepin has been reported to undergo acid-catalyzed rearrangement to give only 2,4,6-trimethylphenol.[7] The arene oxide (or corresponding oxepin) intermediates proposed by analogy to sulfur ylide and pyrylium salt chemistry must be short-lived under the reaction conditions.

We have shown that a variety of pyrylium salts and simple sulfur ylides yield phenols possibly via an arene oxide. We are currently applying this reaction to the synthesis of phenolic natural products.

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REFERENCES

1. a. Garst, M. E., *J. Org. Chem.*, *1979*, *44*, 1578.
   b. Garst, M. E. and Johnson, A. T., submitted.
2. a. Balaban, A. T., Schroth, W. and Fischer, G., *Pyrylium Salts* in "Advances in Heterocyclic Chemistry," *1969*, *Vol. 10*, 341.
   b. Dimroth, K. and Wolf, K. H., "Newer Methods of Preparative Organic Chemistry," *1964*, *Vol. 3*, 357.
3. a. Märkl, G., *Angew. Chem.*, *1962*, *74*, 696.
   b. Ref. 2b, unpublished work cited from the authors' laboratory.
   c. Griffin, D. A. and Staunton, J., *J. C. S. Chem. Comm.*, *1975*, 675.
4. Katritzky, A. R., Rizui, S. Q. A. and Suwinski, J. W., *J. Chem. Soc. Perk. Trans. I*, *1975*, 2489.
5. Corey, E. J. and Chaykovsky, M., *J. Am. Chem. Soc.*, *1965*, *87*, 1353, and Garst, M. E. and Spencer, T. A., *J. Am. Chem. Soc.*, *1973*, *95*, 250.
6. Characterized by nmr, ir and mass spectrum. All yields are isolated yields.
7. Kaubisch, N., Daly, J. W. and Jerina, D. M., *Biochemistry*, *1972*, *11*, 3080.

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