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AN IMPROVED SYNTHESIS OF 2,6-DIPHENYL-4*H*-THIOPYRAN-4-ONE

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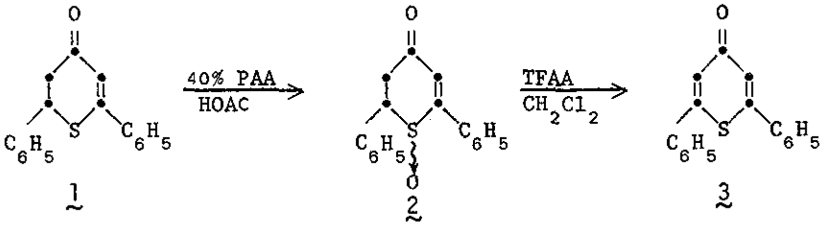
2,6-Diphenyl-4*H*-thiopyran-4-one (**3**) was prepared in high yield by a Pummerer rearrangement of 2,6-diphenyl-4*H*-dihydrothiopyran-4-one-1-oxide (**2**) in the presence of trifluoroacetic anhydride. Acid-catalyzed thermal rearrangement of **2** afforded the isomeric 2-benzylidene-3-keto-5-phenyl-1,2-dihydrothiophene (**4**).

In an earlier paper,[1] the synthesis of 2,6-diphenyldihydro-4*H*-thiopyran-4-one (**1**) from dibenzalacetone *via* an oxidative elimination reaction using N-chlorosuccinimide (NCS) and pyridine was described. This dihydro derivative **1**, on dehydrogenation with selenium dioxide, afforded 2,6-diphenyl-4*H*-thiopyran-4-one (**3**) in an excellent yield. However, concern over the cost and the potential hazards involved in the use of large amounts of toxic selenium dioxide in a large-scale preparation of **3** necessitated the search for an alternate route.[2] A new approach to the synthesis of **3** has now been found.

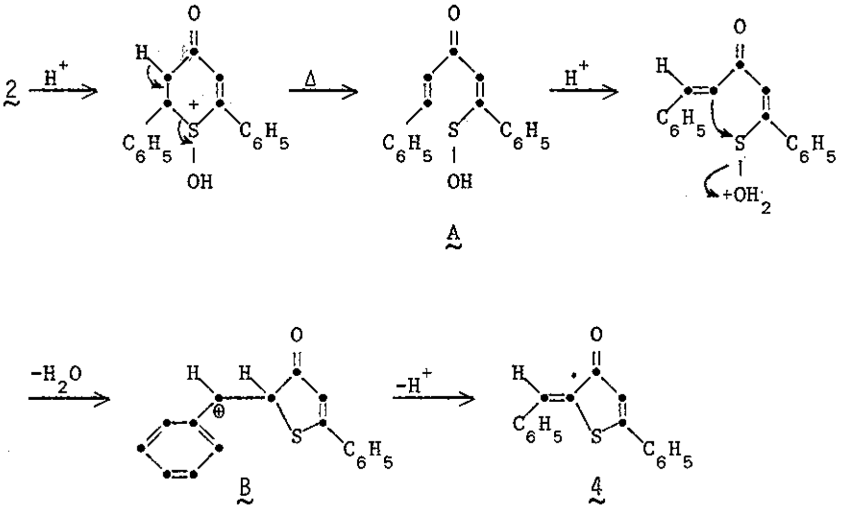


Oxidation of 1 by dropwise addition of 40% peracetic acid (PAA) in acetic acid at *ca*. 20° gave, in an essentially quantitative yield, a diastereomeric mixture of *cis*- and *trans*-2,6-diphenyl-dihydro-4*H*-thiopyran-4-one-1-oxides (2); nmr ($CDCl_3$/TMS): δ2.6-4.4 (*m*, 3H, methylene and methine), 6.53 (*s*, 1H, olefinic), and 7.34 (*m*, 10H, Ar*H*) ppm. An analytical sample was obtained by recrystallization from ether: mp 130-132°; ir (KBr): 1680 (α,β-unsat'd C=O), 1025 (S → O) cm^{-1}. Anal. Calc'd for $C_{17}H_{14}O_2S$: C, 72.3; H, 5.0; S, 11.4. Found: C, 71.8; H, 4.9; S 11.0. *m*-Chloroperbenzoic acid was equally effective in bringing about a high yield of 2. Alternatively, sulfoxide 2 can be prepared from 2,6-diphenyl-tetrahydro-4H-thiopyran-4-one-1-oxide (mp 133-135°)[3] by oxidative elimination using NCS and pyridine.[1] The Pummerer rearrangement[4] was smoothly induced by treating the crude sulfoxide 2 in methylene chloride (cooled, 20°) with approximately 2 equivalents of trifluoroacetic anhydride (TFAA). The darkened mixture was allowed to stir at an ambient temperature for a few hours as the reaction was monitored by tlc (silica gel). Excess TFAA and methylene chloride were removed under reduced pressure. The residue was dissolved in ether, washed (to neutral) with dilute sodium hydroxide and then with water, dried ($MgSO_4$), and concentrated to give, in 90% yield based on 1, 2,6-diphenyl-4*H*-thiopyran-4-one (3), mp 120-125°; nmr ($CDCl_3$/TMS): δ7.0 (*s*, 2H, vinylic) and 7.35 (m, 10H, ArH) ppm. This crude material, which is suitable for pyrylium dye synthesis,[5] can be readily purified by recrystallization from ethyl acetate, mp 131-132° (Lit.,[3] mp 132-133°).

Attempts to use acetic anhydride or p-TsCl and pyridine to effect a Pummerer rearrangement of **2** were not entirely successful. In the latter case, the presence of nucleophilic counterion (Cl^-) in the reaction complicated the reaction products. With acetic anhydride, the rate of the reaction was too slow to be useful at sufficiently mild conditions (r.t.), and heat was detrimental to the desired sulfoxide **2**.

To ascertain the thermal effect on the sulfoxide **2**, we studied the thermal rearrangement of **2** in the presence of a trace of acid. On heating azeotropically a mixture of diastereoisomers **2** in the presence of a small amount of p-toluenesulfonic acid in toluene, we isolated a major product in high yield having the same mass [m/e 264 (M^+) for $C_{17}H_{12}OS$, 263 (M^+-1)] as that of **3**, but having an entirely different nmr spectrum ($CDCl_3$/TMS): δ6.67 (s, 1H), 7.8 (s, 1H), and 7.4 (m, 10H) ppm. The data, including ir [KBr: 1650 (C=O)cm^{-1}], suggest the structure to be the isomeric 2-benzylidene-3-keto-5-phenyl-1,2-dihydrothiophene (**4**) which was previously isolated from the direct cyclization of diphenylethynyl ketone with thioureas and mercaptans.[6]

The formation of the isomeric **4** via the acid-catalyzed thermal rearrangement can be rationalized by the following mechanism. Cyclization of the sulfenic acid intermediate **A**[7] to form the stable benzylic carbonium ion **B** presumably provides the driving force for the ensuing ring contraction.



REFERENCES

1 C. H. Chen, G. A. Reynolds, and J. A. VanAllan, *J. Org. Chem.*, 1977, **42**, 0000.

2 Dehydrogeneration using xenon difluoride on **1** was recently reported by Marko Zupan, *J. Fluorine Chem.*, 1976, **8**, 305.

3 F. Arndt, P. Nachtweg, and J. Pusch, *Chem. Ber.*, 1925, **58**, 1633.

4 G. A. Russell and G. J. Mikol, "Mechanism of Molecular Migrations", Vol. 2, ed. by B. S. Thyagarojan, Interscience Publishers, New York, 1969, pp. 157-207.

5 J. R. Wilt, G. A. Reynolds, and J. A. VanAllan, *Tetrahedron*, 1973, **29**, 795.

6 T. Matler, A. Uchida, and S. I. Miller, Tetrahedron, 1968, **24**, 4285.

7 C. H. Chen and B. A. Donatelli, J. Org. Chem., 1976, **41**, 3053.

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