Tetrahedron Letters,Vol.28,No.49,pp 6219-6220,1987 0040-4039/87 $3.00 + .00
Printed in Great Britain Pergamon Journals Ltd.

NOVEL PALLADIUM CATALYZED SYNTHESIS OF PYRAN DERIVATIVES

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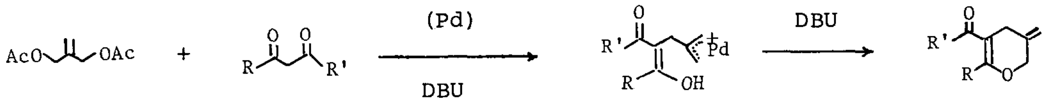
Abstract: Pyran derivatives can be synthesized by the reaction of 2-methylene propane-1,3-diol diacetate (1) with β-diketones or β-ketoesters in the presence of DBU under palladium(0) catalysis.

The palladium catalyzed reactions of allylic compounds with nucleophiles have been studied widely[1]. When β-diketones or β-ketoesters are used as nucleophiles, either C- or O-alkylation will take place depending on the different ligands used[2]. However, palladium catalyzed reactions in which both C- and O-alkylation occur simultaneously by use of such ambident nucleophiles are rare[3].

Here, we wish to report the palladium catalyzed reaction of a bifunctional allylic acetates, 2-methylene propan-1,3-diol diacetate (1), with β-diketones or β-ketoesters (2) bearing two active hydrogen atoms. It is found that those ambident nucleophiles can react with 1 first as a carbon nucleophile, then subsequently as an O-nucleophile to form pyran derivatives in one pot reaction. The carbanion formed will first attack 1 under the catalysis of palladium to form 3, then the O-alkylation takes place intramolecularly to give 4. The yield is moderate. The results are shown in Table.



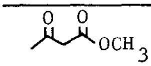
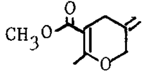
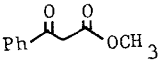
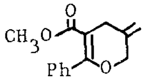
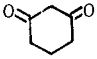
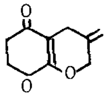
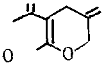
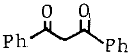
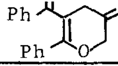
1 2 3 4

The following procedure is typical: To a stirred solution of 1 (400 mg. 2.3 mmol), methyl acetoacetate (2a, 230 mg, 2mmol), Pd(OAc)$_2$ (22 mg, 0.1 mmol), PPh$_3$ (100 mg, 0.39 mmol) in THF (5 ml), DBU (690 mg, 4.5 mmol) was added with a syringe under argon atmosphere. The solution was stirred at room temperature until the disappearance of 2a as monitored by TLC. Water was added, the mixture was extracted with ether and the ether solution was dried with MgSO$_4$. After distilling off the ether, the product 4a (170 mg) was isolated by chromatographic purification on alumina.

The presence of a six membered oxygen heterocycle ring in a range of naturally occurring compounds provided the stimulus for the development of synthetic routes to these compounds[4]. Our results provides a convenient and simple synthetic method for these compounds.

The reactions of 1 with other nucleophiles are being investigated in our laboratory.

Table. Palladium Catalyzed Synthesis of Pyran Derivatives (4)

Nucleophile		Time (h)	Product[a]		Isolated Yield (%)
	(2a)	3		(4a)	51
	(2b)	3		(4b)	65
	(2c)	5		(4c)	52
	(2d)	3		(4d)	84[b]
	(2e)	5		(4e)	55

a: All compounds gave satisfactory ^{1}H NMR, IR and MS data.
b: Determined by G.C.

Acknowledgement: Thanks are due to the National Natural Science Foundation of China for financial support.

References and Notes:

1. For reviews see (a) Tsuji, J., "Organic Synthesis with Palladium Compounds", Springer Verlag, Berlin, 1980; (b) Tsuji, J., Pure Appl. Chem. 1982, 54, 197; (c) Trost, B, M., Tetrahedron, 1977, 33, 2615; (d) Trost, B. M., Acc. Chem. Res., 1980, 13, 385.

2. (a) Tsuji, J., Kobayashi, Y., Kataoka, H. and Takahashi, T., Tetrahedron Lett., 1980, 21, 1475; (b) Trost, B. M., Runge, T, A. and Jungheim, L. N., J. Am. Chem. Soc., 1982, 102, 2840.

3. (a) Tsuji, J., Watanabe, H., Minami, I. and Schimizu, I., J. Am. Chem. Soc., 1985, 107, 2196; (b) Minami, I., Yuhara, M. and Tsuji, J., Tetrahedron Lett., 1987, 28, 629.

4. (a) Hepworth, J. D. in "Comprehensive Heterocyclic Chemistry", Eds. Katritzky, A. amd Rees, C. W., Vol. 3, Pergamon Press, Oxford, 1984, p.737, (b) Seoano, C., Soto, J. L. and Quinteriro, M., Heterocycles, 1980, 14, 337.

5. 4a: B.p. 60-80°C(oil bath)/2mm Hg; IR(neat): 1710, 1660, 1620; ^{1}H NMR (CCl$_4$, 60 MHz): 2.16(s, 3H), 2.96(s, 2H), 3.62(s, 3H), 4.30(s, 2H), 5.05(m, 2H); MS: 169(M$^+$+1), 153, 137, 109, 43; Calcd. exact mass for $C_9H_{12}O_3$: 168.0786, found: 168.0789.

4b: Oil; IR(neat):1720, 1695, 1620, 1600, 770, 700; ^{1}H NMR(CCl$_4$, 60 MHz): 3.13(s, 2H), 3.35(s 3H), 4.45(s 2H), 5.10(m, 2H), 7.5(s, 5H); MS: 230(M$^+$),215, 171, 105, 77, 51; Calcd. exact mass for $C_{14}H_{14}O_3$: 230.0943, found:230.0946.

4c: B.p. 85-100°C(oil bath)/0.8 mm Hg; IR(neat): 1720, 1650, 1610; ^{1}H NMR (CCl$_4$, 60 MHz): 1.70-2.60(m, 6H), 2.90(s, 2H), 4.40(s, 2H), 5.15(broad, 2H); MS: 164(M$^+$), 149, 136, 108; Calcd. exact mass for $C_{10}H_{12}O_2$: 164.0837, found: 164.0830.

4d: B.p. 60-80°C(oil bath)/16 mm Hg; IR(neat): 1700, 1670, 1580; ^{1}H NMR (CCl$_4$, 60 MHz): 2.15(s, 3H), 3.05(s 2H), 4.30(s, 2H), 5.05(broad, 2H); MS: 152 (M$^+$), 137, 109, 43; Calcd. exact mass for $C_9H_{12}O_2$: 152.0827, found: 152.0828.

4e: IR(KCl): 1710, 1650(broad), 1595, 770, 695; ^{1}H NMR(CCl$_4$, 60 MHz): 3.2(s, 2H), 4.5(s, 2H), 5.0(broad,2H), 6.7-7.2(m, 8H), 7.2-7.5(m, 2H); MS: 276(M$^+$), 199, 171, 105, 77; Calcd. exact mass for $C_{19}H_{16}O_2$: 276.1160, found: 276.1170.

(Received in Japan 28 August 1987)