59 (11), 57 (28), 43 (52). Anal. Calcd for $C_9H_{16}O_6$: C, 49.09; H, 7.32. Found: C, 49.15; H, 7.21.

2,4,4,5-Tetramethoxy-3-hydroxy-5-methyltetrahydrofuran (5): oil; ^{1}H NMR δ 4.93 (d, 1 H, J = 5.2 Hz), 4.04 (dd, 1 H, J = 5.2 and 10.5 Hz), 3.54 (s, 3 H), 3.43 (s, 3 H), 3.35 (s, 3 H), 3.3 (s, 3 H), 3.05 (d, OH, J = 10.5 Hz), 1.4 (s, 3 H); ^{13}C NMR δ 106.6, 104.9, 102.5, 72.2, 56.4, 51.0, 49.7, 48.6, 17.6; MS m/z (relative intensity) 191 (1), 145 (11), 131 (100), 117 (53), 85 (16), 75 (44), 59 (13), 57 (7), 43 (26). Anal. Calcd for $C_9H_{18}O_6$: C, 48.65; H, 8.16. Found: C, 48.58; H, 8.21.

2,4,4,5-Tetramethoxy-5-phenyltetrahydrofuran-3-one (4c): oil; ^{1}H NMR δ 7.7–7.55 (m, 2 H), 7.5–7.3 (m, 3 H), 5.15 (s, 1 H), 3.6 (s, 3 H), 3.4 (s, 3 H), 3.3 (s, 3 H), 3.1 (s, 3 H); MS m/z (relative intensity) 251 (4), 194 (3), 179 (27), 146 (100), 131 (28), 117 (34), 105 (59), 77 (39), 75 (43), 59 (12). A second isomer could be detected by ^{1}H NMR and GLC–MS: ^{1}H NMR δ 7.7–7.55 (m, 2 H), 7.5–7.3 (m, 3 H), 4.9 (s, 1 H), 3.65 (s, 3 H), 3.38 (s, 3 H), 3.28 (s, 3 H), 3.15 (s, 3 H); MS m/z (relative intensity) 251 (2), 194 (3), 179 (35), 146 (100), 131 (29), 117 (33), 105 (56), 77 (36), 75 (41), 59 (10). Anal. Calcd for $C_{14}H_{18}O_6$: C, 59.57; H, 6.43. Found: C, 59.71; H, 6.32.

Acknowledgment. Financial support from the CNR, Rome, Progetto Finalizzato "Chimica Fine II", and Ministero della Università e della Ricerca Scientifica e Tecnologica, Italy is gratefully acknowledged.

Registry No. **1a**, 123-54-6; **1b**, 3002-24-2; **1c**, 93-91-4; **1d**, 120-46-7; **1e**, 5331-64-6; **1f**, 606-23-5; **1g**, 105-45-3; **1h**, 5396-89-4; **1i**, 30414-53-0; **1j**, 3249-68-1; **1k**, 94-02-0; **2a**, 134390-33-3; **2b**, 134390-34-4; **2c**, 134390-35-5; **2d**, 134390-36-6; **2e**, 134390-37-7; **2f**, 65299-21-0; **2g**, 68057-56-7; **2h**, 134390-38-8; **2i**, 134390-39-9; **2j**, 134390-40-2; **2k**, 134390-41-3; **3a**, 134390-49-1; **3b**, 134390-42-4; **3c**, 134390-43-5; **3g**, 90690-66-7; **3h**, 134390-44-6; **4a**, 134390-46-8; **4b**, 134390-51-5; **4c** (isomer 1), 134390-48-0; **4c** (isomer 2), 134390-50-4; **5**, 134390-47-9; **6**, 643-75-4; **7**, 134390-45-7; PhSeSePh, 1666-13-3; ammonium peroxydisulfate, 7727-54-0.

Substituted γ-Lactones: Reactions of (Arylmethylene)furandiones with Nucleophiles. A Novel Approach to the Cyclolignan Lactone Skeleton[1]

Adel Amer,[2] Douglas Ho, Klaus Rumpel, Ralf I. Schenkel, and Hans Zimmer*

Department of Chemistry, University of Cincinnati, Cincinnati, Ohio 45221-0172

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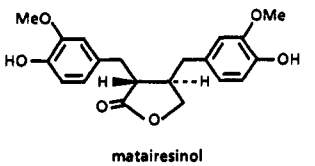
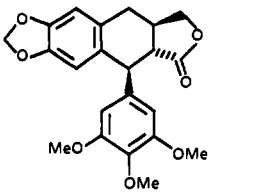
Introduction

In the field of cancer research, an important class of natural products derived formally from the dimerization of 3-phenylpropane precursors,[3] namely, lignan lactones, is well recognized.[4] The many varied types of structures that lignan lactones can possess, e.g., **1–3**, ..., etc., have presented a considerable challenge to organic chemists over the years and indeed many elegant syntheses for their skeleton have been reported.[5,6]



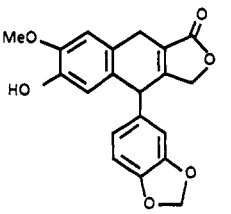
matairesinol

1



(-)-isodeoxypodophyllotoxin

2



Konyanin

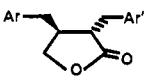
3

Of particular interest to us are type 1 compounds for which we devised the first synthesis of their unsymmetrical analogues **4**.[7]

In the continuation of studies of the chemistry of β- and α-tetronic acids **5** and **6**, we wish to report our finding in utilizing these molecules in building up the lignan lactone skeleton.

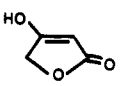
Results and Discussion

Retrosynthetically, the construction of **4** can be approached in a convergent manner and would involve a

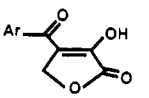


4

Horner–Emmons reaction of a phosphonate carbanion such as the anion derived of diethyl benzylphosphonate (**9**) with the ketonic group of either **7** or **8** (formally obtained from **5** or **6** respectively)[8,9] followed by a hydrogenation of the double bonds and epimerization by base at C-3.



5



6

A Horner–Emmons reaction of **7** with **9**, however, failed to produce the desired 1,2-adduct. Instead **7** reacted as a Michael acceptor yielded compounds of type **10**. Their structural assignments were based on elemental analysis and spectroscopic data (Scheme I).

The existence of several studies concerning the factors governing the reactivity of stabilized carbanions such as **9** with α,β-unsaturated carbonyl compounds as to 1,2- versus 1,4-addition, e.g., Horner–Emmons fashion or Michael addition,[10,11] prompted us to apply a number of

(1) This is part 37 of the series Substituted γ-Butyrolactones. For part 36 of this series, see: Zimmer, H.; Amer, A.; Chiem Van Pham; Schmidt, D. S. *J. Org. Chem.* **1988**, *53*, 3368.

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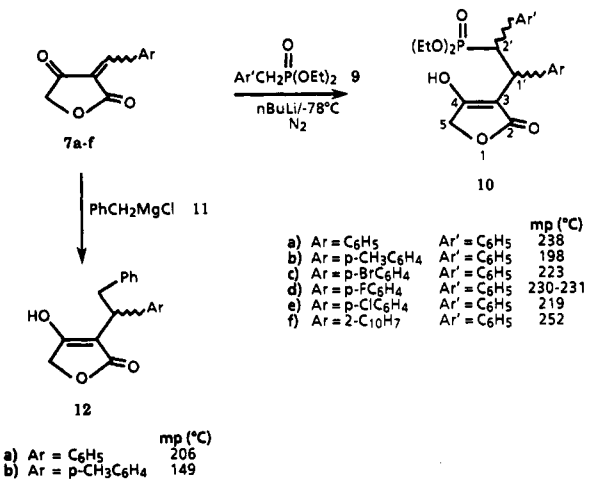
0022-3263/91/1956-5210$02.50/0

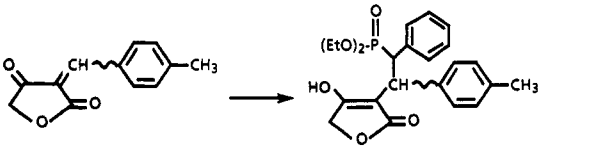
Scheme I



		Ar'	mp (°C)
a)	Ar = C_6H_5	C_6H_5	238
b)	Ar = p-$CH_3C_6H_4$	C_6H_5	198
c)	Ar = p-BrC_6H_4	C_6H_5	223
d)	Ar = p-FC_6H_4	C_6H_5	230-231
e)	Ar = p-ClC_6H_4	C_6H_5	219
f)	Ar = 2-$C_{10}H_7$	C_6H_5	252

		mp (°C)
a)	Ar = C_6H_5	206
b)	Ar = p-$CH_3C_6H_4$	149

Table I



	Applied Condition	Yield of (1,4) Product
1]	n-BuLi / THF, -78°C → H_2O, RT	24%
2]	n-BuLi / THF-hexane, -78°C → H_2O	no reaction
3]	[12-Crown-4]-THF, n-BuLi/-78°C → H_2O, RT	58%
4]	n-BuLi-t-BuOK/THF, -78°C → H_2O, RT	25%
5]	NaH / THF, -35°C → H_2O	15%

different conditions that reportedly led to formation of 1,2-additions. However, in the present system only 1,4-additions were observed (Table I).

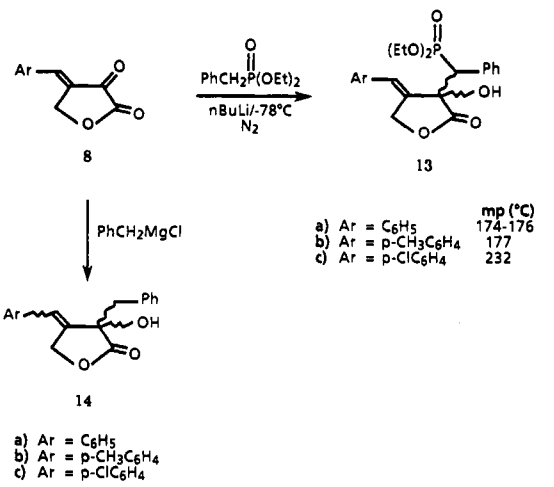
Since nonhindered Grignard reagents add preferentially in a 1,2-fashion to conjugated systems,[12] we, in order to get the desired lignan skeleton **4**, condensed **7** with benzylmagnesium chloride (**11**). However, this reaction also went in a Michael-type fashion to afford 3-(1′,2′-diarylethyl)-4-hydroxy-2(5*H*)-furanones **12** (Scheme I).

The unsuccessful attempts using **7** as well as the difference in the calculated partial atomic charges of **7** versus **8** led us to adopt the latter for the construction of the desired lignan skeleton. Thus, the reaction of **8a** with **9** was performed under reaction conditions similar to the ones used for the condensations involving **7**. The reaction in this case proceeded with 1,2-addition to give **13a** with no simultaneous 1,4-addition product formed (Scheme II).

The structural elucidation of **13a** is based on elemental analysis and spectroscopic investigations. NMR assignments (Experimental Section) confirmed that **13a** has an *E* configuration. No trace of the corresponding *Z* isomer was observed in the reaction mixture. Similarly, compounds **13b** and **13c** were synthesized.

Reacting **8** with **11** afforded **14** also via a 1,2-addition reaction as happened with the phosphonate-stabilized

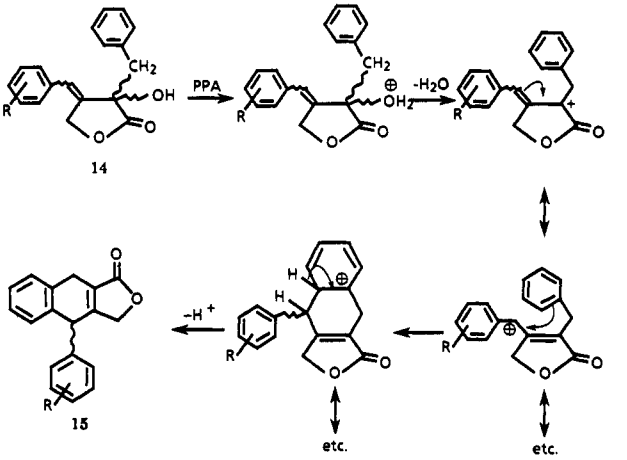
Scheme II



		mp (°C)
a)	Ar = C_6H_5	174-176
b)	Ar = p-$CH_3C_6H_4$	177
c)	Ar = p-ClC_6H_4	232

a) Ar = C_6H_5
b) Ar = p-$CH_3C_6H_4$
c) Ar = p-ClC_6H_4

Scheme III



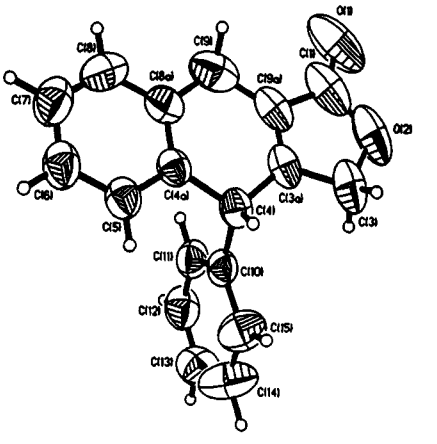


Figure 1.

carbanion to afford **13**. However, the ^1H NMR spectra of **14a–c** were more complicated than those of **13**. They were characterized by two different sets of methylene protons at C-5 of the furane ring. Compound **14a** was chosen as prototype for detailed investigation. Its ^1H NMR spectrum revealed the presence of a mixture of *E* and *Z* isomers. A 2D-COSY experiment also confirmed this fact. A plausible explanation for these results is to assume the reaction to proceed via a competing single-electron transfer (SET)[13-16]

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mechanism or a reversible 1,4-addition.

Dehydration, hydrogenation, and a subsequent epimerization of **14** seem to be the only three steps necessary to achieve the goal of a new synthesis of lignans of the α,β-unsymmetrically substituted γ-butyrolactone class **4**. However, when **14** was treated with poly(phosphoric acid) (PPA), it underwent a dehydrative cyclization to a cyclolignan of the 1,4-dihydronaphthalene type **15** (Scheme III). The structural assignment of **15** again was based on elemental analysis and spectroscopic data and secured by X-ray analysis. A perspective view of the molecule in the unit cell of **15a** is presented in Figure 1.

An explanation for the formation of **15** can be visualized by a 1,3-shift to yield a highly resonance stabilized carbocation. A nucleophilic attack by the α-aryl group on this cation and loss of a proton completes the transformation of **14** into the cyclolignan lactone skeleton of type **15** (Scheme III). Cyclodehydration of unrelated substituted lactone precursors were previously documented to afford only the tetralin ring system.[18,19]

Conclusion

The reaction sequence presented here provides a simple and first synthesis for the cyclolignan lactone skeleton of the 1,4-dihydronaphthalene system occurring in konyanin (**3**).[20]

Experimental Section

Melting points are uncorrected. Analytical TLC was performed by using the ascending technique with EM silica gel 60 F_{254} precoated on plastic sheets. ^1H NMR spectra were recorded at 250 or 300 MHz. GC-MS data were obtained at 70 eV. X-ray data were recorded on a Nicolet R3m diffractometer and analyzed on a MicroVAX II using the SHTLXTL PLUS series of crystallographic programs.

3-[1′,2′-Diaryl-2′-[bis(ethyloxy)phosphinyl]ethyl]-4-hydroxy-2(5*H*)-furanone 10. General Procedure. To a stirred cold solution of diethyl benzylphosphonate (5 mmol) in THF at −78 °C was added *n*-butyllithium (5.1 mmol) under N_2. The reaction mixture was left for 15 min before the addition of a solution of **7** (5 mmol) in THF (50 mL). After standing at −78 °C for 15 min, it was allowed to reach rt. The solvent was removed, water (25 mL) was added, and the reation mixture was neutralized with dilute HCl and extracted with diethyl ether. The ether layer was dried ($MgSO_4$) and evaporated. The residue was recrystallized from ethyl acetate to give **10**.

3-[2′-[Bis(ethyloxy)phosphinyl]-1′,2′-diphenylethyl]-4-hydroxy-2(5*H*)-furanone (10a): yield 0.52 g (25%) of a colorless crystalline solid; mp 238 °C; ^1H NMR ($CDCl_3$) δ 0.9 (m, 6 H), 3.5 (m, 4 H), 3.99, 4.12 (2 d, 2 H, J = 15.9 Hz), 4.70 (dd, 1 H, J = 19.0, 12.6 Hz), 5.45 (dd, overlapping, 1 H, J = 13.0, 12.6 Hz), 7.30 (m, 5 H), 7.85 (m, 5 H), 12.1 (s, 1 H, D_2O exchangeable); MS (CI) m/e 417 $(M + 1)^+$; IR (KBr) 1745, 1653 cm^{-1}. Anal. Calcd for $C_{22}H_{25}O_6P$: C, 63.46; H, 6.04. Found: C, 63.44; H, 6.04.

3-[2-[Bis(ethyloxy)phosphinyl]-1′-(4-methylphenyl)-2′-phenylethyl]-4-hydroxy-2(5*H*)-furanone (10b): yield 0.52 g (24%) of colorless crystalline solid; mp 198 °C; ^1H NMR ($CDCl_3$) δ 0.9 (m, 6 H), 2.4 (s, 3 H), 3.5 (m, 4 H), 3.99, 4.12 (2 d, 2 H), 4.70 (dd, 1 H), 5.45 (dd, overlapping 1 H), 7.30 (m, 5 H), 7.85 (m, 4 H), 12.1 (s, 1 H, D_2O exchangeable); IR (KBr) 1745, 1653 cm^{-1}. Anal. Calcd for $C_{23}H_{27}O_6P$: C, 64.22; H, 6.28. Found: C, 64.12; H, 6.37.

3-(1′-Aryl-2′-phenylethyl)-4-hydroxy-2(5*H*)-furanone 12. General Procedure. To a cold solution of **7** (5 mmol) in THF (50 mL) at −16 °C was added **11** (2 M solution in THF) (5 mmol) over a period of 10 min with stirring. After 30 min the reaction mixture was heated slowly to 40 °C and kept there for 1 h. It was poured onto water and then acidifed by dilute HCl to pH 5.6 and extracted with $CHCl_3$. The organic layer was dried over anhydrous $MgSO_4$ and then evaporated, and the residue was recrystallized from ethyl acetate.

3-(1′,2′-Diphenylethyl)-4-hydroxy-2(5*H*)-furanone (12a): yield 0.7 g (50%) of a colorless solid; mp 206 °C; ^1H NMR ($CDCl_3$–DMSO-d_6) δ 3.10–3.50 (m, 2 H), 4.10 (m, 1 H), 4.39 (s, 2 H), 7.25 (m, 10 H), 10.8 (s, 1 H, D_2O exchangeable); IR (KBr) 1710, 1653 cm^{-1}; MS (EI) m/e 280 ($M^{\bullet+}$, 4), 262 (2), 189 (56), 91 (100). Anal. Calcd for $C_{18}H_{16}O_3$: C, 77.12; H, 5.75. Found: C, 76.89; H, 5.67.

3-[1′-(4-Methylphenyl)-2′-phenylethyl]-4-hydroxy-2-(5*H*)-furanone (12b): yield 0.65 g (44%) of a colorless solid; mp 149 °C; ^1H NMR ($CDCl_3$) δ 2.29 (s, 3 H), 3.33 (dd, 2 H), 3.99 (dd, 1 H), 4.40 (s, 2 H), 7.25 (m, 9 H), 11.50 (s, 1 H, D_2O exchangeable); IR (KBr) 1713, 1637 cm^{-1}; MS (EI) m/e 294 ($M^{\bullet+}$, 4), 276 (3), 203 (36), 91 (100). Anal. Calcd for $C_{19}H_{18}O_3$: C, 77.53; H, 6.16. Found: C, 77.36; H, 5.96.

4-((*E*)-Arylmethylene)-3-[[bis(ethyloxy)phosphinyl]-phenylmethyl]-3,4-dihydro-2(5*H*)-furanone 13. General Procedure. The procedure was the same as that above for **10**, using **8** instead of **7**.

3-[[Bis(ethyloxy)phosphinyl]phenylmethyl]-3-hydroxy-4-((*E*)-phenylmethylene)-3,4-dihydro-2(5*H*)-furanone (13a): yield 1.9 g (92%) of a colorless crystalline solid; mp 174–176 °C; ^1H NMR ($CDCl_3$) (300 MHz) δ 0.91, 1.21 (2 t, 6 H), 3.76, 4.01 (2 m, 5 H), 4.97 and 5.18 (2 dd, $J_{H5,H5'}$ = 14.32, $J_{H5,H6}$ = 1.5, $J_{H5',H6}$ = 2.4 Hz, 2 H), 6.15 (bs, 1 H), 6.50 (d, 1 H, D_2O exchangeable), 7.299 (m, 10 H); IR (KBr) 3260, 1780 cm^{-1}; MS (EI) m/e 416.1382 ($M^{\bullet+}$, 1.24), 228.0921 (100). Anal. Calcd for $C_{22}H_{25}O_6P$: C, 63.45, H, 6.05. Found: C, 63.51; H, 6.15.

4-((*E*/*Z*)-Arylmethylene)-3-benzyl-3-hydroxy-3,4-dihydro-2(5*H*)-furanone 14. General Procedure. The procedure was the same procedure as for **12**, using **8** instead of **7**. The reaction product was purified by column chromatography using ethyl acetate and/or ether as eluent.

3-Benzyl-3-hydroxy-4-(phenylmethylene)-3,4-dihydro-2-(5*H*)-furanone (14a): yield 0.98 g (70%) of yellowish oily product; ^1H NMR (80 MHz; $CDCl_3$) δ 3.29 (m, 2 H), 2.7 (bs, 1 H), 4.54 (m, 3 H) 6.7, 7.30 (s, m, 11 H); (300 MHz) 3.21 (dd, J = 13.16 Hz, 1.3 H), 3.32 (dd, J = 7.35 Hz, 0.4 H), 3.37 (dd, J = 8.82 Hz, 0.3 H), 3.86 (bs, 1 H), 4.15, 4.81 (2 dd, $J_{H5,H5'}$ = 13.48, $J_{H5,H1'}$ = 2.28, $J_{H5',H1'}$ = 1.97 Hz, 1.34 H (*E* form)), 4.36, 4.51 (2 d, $J_{H5,H5'}$ = 16.14 Hz, 0.66 H (*Z* form)), 6.73 (bs, 0.66 H), 7.20 (m, 10.34 H); MS (EI) m/e 280 ($M^{\bullet+}$, 5), 189 (50), 142 (40), 91 (100); HRMS calcd for $C_{18}H_{16}O_3$ ($M^{\bullet+}$) 280.1099, found 280.1116.

3-Benzyl-3-hydroxy-4-[(4-methylphenyl)methylene]-3,4-dihydro-2(5*H*)-furanone (14b): yield 1.03 g (70%) of a yellowish oily product; ^1H NMR ($CDCl_3$) δ 2.29 (s, 3 H), 3.29 (m, 2 H), 4.54 (m, 2 H), 6.70–7.30 (m, 9 H); MS (EI) m/e 294 ($M^{\bullet+}$, 22), 203 (52), 182 (45), 108 (59), 91 (100). Anal. Calcd for $C_{19}H_{18}O_3$: C, 77.53; H, 6.16. Found: C, 77.31; H, 6.30.

3-Benzyl-4-[(4-chlorophenyl)methylene]-3-hydroxy-3,4-dihydro-2(5*H*)-furanone (14c): yield 0.7 g (44%) of a yellowish oily product; ^1H NMR ($CDCl_3$) δ 3.30 (m, 2 H), 4.50 (m, 2 H), 6.70–7.30 (m, 9 H); MS (EI) m/e 314 ($M^{\bullet+}$, 3), 91 (100). Anal. Calcd for $C_{18}H_{15}ClO_3$: C, 68.69; H, 4.77. Found: C, 68.48; H, 4.86.

4-Aryl-4,9-dihydronaphtho[2,3-*c*]furan-1(3*H*)-one 15. General Procedure. To compound **16** (5 mmol) was added polyphosphoric acid (8 g), and the mixture was heated at 80 °C for 1 h. The reaction mixture was poured onto crushed ice. The oily product was extracted with $CHCl_3$, and the organic layer was separated, dried over anhydrous $MgSO_4$, and evaporated. The residue was recrystallized from carbon tetrachloride and then isopropyl alcohol to give **15**.

4-Phenyl-4,9-dihydronaphtho[2,3-*c*]furan-1(3*H*)-one (15a): yield 0.58 g (44%) of bright faint yellow crystals; mp 130–131 °C; ^1H NMR ($CDCl_3$) δ 3.74 (m, 2 H), 4.46, 4.74 (2 d, 2 H), 4.93 (m, 1 H), 7.2 (m, 9 H); MS (EI) m/e 262 ($M^{\bullet+}$, 0.5), 121 (29), 117 (100), 82 (27). Anal. Calcd for $C_{18}H_{14}O_2$: C, 82.42; H, 5.38. Found: C, 82.67; H, 5.22.

4-(4-Methylphenyl)-4,9-dihydronaphtho[2,3-*c*]furan-1-(3*H*)-one (15b): yield 0.66 g (48%) of a pale yellow crystalline

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solid; mp 123 °C; ^{1}H NMR ($CDCl_3$) δ 2.29 (s, 3 H), 3.74 (m, 2 H), 4.46, 4.74 (dd, 2 H), 4.93 (t, 1 H), 7.2 (m, 8 H); IR (KBr) 1713, 1653 cm^{-1}; MS (EI) *m/e* 276 ($M^{+\cdot}$, 70), 261 (15), 232 (34), 91 (25), 77 (15), 82 (18), 43 (100). Anal. Calcd for $C_{19}H_{16}O_2$: C, 82.58, H. 5.84. Found: C, 82.42; H, 6.00.

4-(4-Chlorophenyl)-4,9-dihydronaphtho[2,3-*c*]furan-1-(3*H*)-one (15c): yield 0.67 g (45%) of a pale yellow crystalline solid; mp 160 °C; ^{1}H NMR ($CDCl_3$) δ 3.80 (m, 2 H), 4.50, 4.70 (dd, 2 H), 4.93 (t, 1 H), 7.2 (m, 8 H); IR (KBr) 1723, 1658 cm^{-1}; MS (EI) *m/e* 296 ($M^{+\cdot}$, 51), 252 (35), 217 (100). Anal. Calcd for $C_{18}H_{13}O_2Cl$: C, 72.85; H, 4.42. Found: C, 72.83; H, 4.53.

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Supplementary Material Available: X-ray data for **15a** including atomic coordinate and equivalent isotropic displacement parameters, anisotropic temperature parameters, bond lengths and angles, and physical properties data including ^{1}H and ^{13}C NMR spectra of **10c-f** and **13b-c** (15 pages). Ordering information is given on any current masthead page.

Aryl-Substituted Cyclic Homoaldol Products Derived from (α-Alkoxybenzyl)trimethylsilanes

Russell J. Linderman,* Ameen Ghannam, and Ibraheem Badejo

Department of Chemistry, North Carolina State University, Raleigh, North Carolina 27695-8204

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We have been studying the synthetic utility of α-alkoxyorganocuprate reagents in the stereoselective generation of homoaldol products. Although we were able to achieve excellent yields of 1,4-addition products to cyclic and acyclic enones,[1] and high diastereoselectivity in additions to acyclic enals,[2] the cuprate methodology was limited to alkyl-substituted α-alkoxyorganocuprates. Attempts to prepare aryl-substituted cyclic homoaldol products using aryl-substituted α-alkoxyorganocuprates were fraught with low yields and considerable amounts of undesirable dimerization of the cuprate species.[1c] In an effort to surmount the difficulties involved in the generation of aryl-substituted cyclic homoaldol products, we have investigated the potential utility of silyl-derived aryl-substituted α-alkoxy carbanions. The nucleophilic desilylation of organosilanes as a means of generating synthetically useful carbanions has been reviewed.[3] In particular, allylsilanes have been used extensively in electrophilic addition reactions.[4] Aryl anions derived from trimethylsilyl-substituted heteroaromatic silanes[5] and benzylic anions from aryl and heteroaryl benzylsilanes[6] have also been reported. In particular, Ricci and co-workers[7] described the fluoride-initiated regioselective addition of benzyltrimethylsilane to cyclohexenone, while Bennetau and co-workers[8] reported regioselective 1,2-addition of the same reagent to enals. We now wish to report highly regioselective 1,4-addition of several [α-(methoxymethoxy)benzyl]trimethylsilanes to cyclic enones.

Several substituted (α-hydroxybenzyl)trimethylsilanes were prepared in good overall yield from the appropriate benzaldehyde derivative via the reverse Brook rearrangement methodology we have described.[9] Protection of the alcohol as the methoxymethyl (MOM) ether was achieved in excellent yield under standard reaction conditions ($iPrNEt_2$, MOMCl, 0 °C).[1c] Aqueous quench of the reaction mixture of **1** and CsF in DMF provided a nearly quantitative yield of the desilylated MOM-protected benzyl alcohol **2**. In contrast to the facile reaction of α-alkoxyalkyl lithio anions with DMF,[10] no trace of the possible formylation product was detected. Direct 1,2-addition of **1** to butyraldehyde provided an 82% isolated yield of the monoprotected diol **3**. Attempted 1,2-addition of **1** to ketones provided <10% of the addition products. The silyl-derived benzyl anion was also completely unreactive toward saturated and unsaturated esters and was an inefficient nucleophile toward alkylation with allyl or benzyl bromide (<15% isolated yields). The reactivity of α-alkoxyalkyl lithio anions derived by transmetalation of the corresponding stannane[10,11] or deprotonation of carbamate derivatives of benzyl alcohol[12] toward alkylation is distinctively greater than that observed for **1**.

Regioselective 1,4-addition of several [α-(methoxymethoxy)benzyl]trimethylsilanes was obtained with cyclic enones (see Table I). The aryl-substituted cyclic homoaldol products **8-17** were obtained as mixtures of diastereomers from silanes **1** and **4-7** in 42-85% yield. Only the 2,4-dimethoxy-functionalized silane **4** produced a significant, albeit minor, amount of 1,2-addition product (<6%). Optimized reaction conditions involved in situ reaction of

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