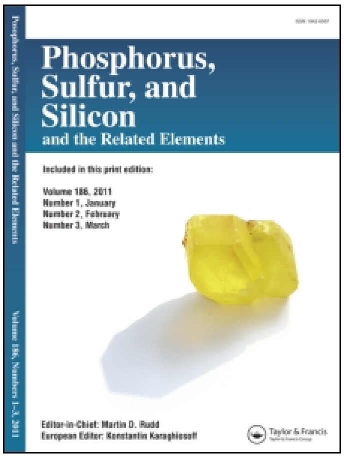

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A One-Pot and Convenient Synthesis of Coumarins in Solventless System

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A ONE-POT AND CONVENIENT SYNTHESIS OF COUMARINS IN SOLVENTLESS SYSTEM

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An efficient and facile preparation of simple coumarins via in situ Wittig reaction of salicylaldehydes, triphenylphosphine, and chloroethylacetate supported on MgO in satisfactory yields in solvent-free condition.

Keywords: Coumarin; solventless system; Wittig reaction

Coumarins are common in nature and find their main applications as fragrances, pharmaceuticals, and agrochemicals.[1] In addition, some coumarins are of much interest as a result of their toxicity,[2a] carcinogenity,[2b] and photodynamic effects.[2c]

Many synthetic methods for coumarins have been developed.[3] Takashi et al. reported the synthesis of simple coumarins (3,4-unsubstituted) via the Wittig reaction of salicylaldehydes and carbethoxymethylenetriphenylphosphorane in diethylanline under reflux condition.[4] It has been well documented in the literature that Wittig reactions of the stable ylids with aldehydes are much slower, especially in nonpolar solvents.[5] Other methods including the Perkin, Knoevenagel, and Pechmann reactions are known for the synthesis of coumarins,[6] these methods have their own merits and disadvantages, therefore introduction of new methods based on green chemistry is still in demand.

Inorganic supports have the ability to enhance the reaction rates for many types of organic reactions[7] and we have used them in our laboratory.[8] In this article we report on the Wittig reaction of in situ prepared carbethoxymethylenetriphenylphosphorane and salicylaldehydes supported on MgO for the rapid and one-pot synthesis of simple coumarins in solvent-free condition.

We found that simple coumarins can be obtained in a single step and in good yields. The mixture of salicylaldehydes (or its derivatives) **1**,

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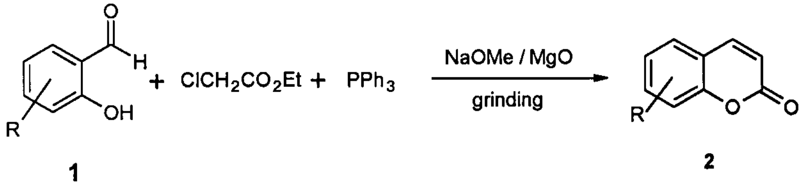
triphenylphosphine, and chloroethylacetate, impregnated on MgO furnished on grinding coumarins **2** (Scheme 1). It is noteworthy to mention that addition of sodium methoxide enhances the rate of reaction and in no case undesired products (like trans-cinnamates) in addition to coumarins were detected.



SCHEME 1

EXPERIMENTAL

Melting points were measured on an electrothermal 9100 apparatus and are uncorrected. IR spectra were recorded on Bruker 843 instrument and ^{1}H-NMR spectra on Bruker (60 MHz) spectrometers. Dry-column flash chromatography was carried out on silica gel (Merck, 15111). The synthetic samples were identified by comparision of spectra (^{1}H-NMR, IR) data with those of commerical or synthetic samples or by comparision with physical data in the cited references (Table I).

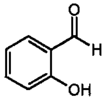
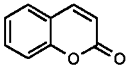
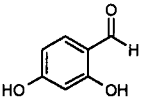
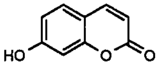
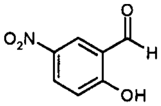
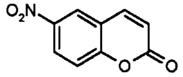
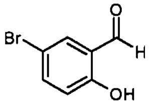
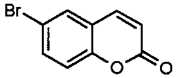
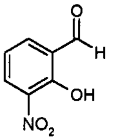
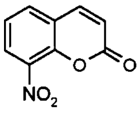
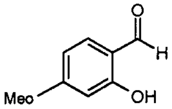
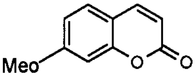
GENERAL PROCEDURE

Salicylaldehyde (14.5 mmol), chloroethylacetate (15 mmol), triphenylphosphine (14.5 mmol), and sodium methoxide (14.5 mmol) were supported on MgO (3 g) and was ground to make an intimate mixture. The progress of the reaction was monitored by TLC using (hexane/ethylacetate) as solvent. After the completion of the reaction the mixture was dissolved in acidic water and extracted with ether. The residue after evaporating ether was directly subjected to dry-column flash chromatography using hexane/ethylacetate as solvent to obtain the coumarin.

Selected Spectroscopic Data

2a: ^{1}HNMR δ ($CDCl_3$): 6.48 (d, 1H, olefinic CH), 7.3–7.65 (m, 4H, aromatic protons), 7.8 (d, 1H, olefinic CH); IR, ν (KBr disc): 1710, 1610, 1450, 1400 Cm^{-1}.

TABLE I Preparation of Simple Coumarins in Solventless System

			Product m.p. (°C)		
Entry	Substrate	Product	Found	(Reported)ref.	Yield (%)
a			67–68	(68–70)[9]	82
b			230–232	(234–235)[10]	85
c			178–179	(181–182)[11]	90
d			161–163	(161–163)[12]	84
e			187–189	(190–191)[13]	85
f			115–117	(118–119)[14]	87

2b: ^{1}HNMR δ (acetone d_6): 6.25 (d, 1H, olefinic CH), 6.9–7.8 (m, 3H, aromatic protons), 7.9 (d, 1H, olefinic CH), 9.4 (s, 1H, OH); IR, ν (KBr disc): up to 3000 (OH broad), 1720, 1680, 1620 Cm^{-1}.

2c: ^{1}HNMR δ (acetone d_6): 6.3 (d, 1H, olefinic CH), 7–7.7 (m, 3H, aromatic protons), 7.85 (d, 1H, olefinic CH), IR, ν (KBr disc): 1715, 1620, 1550, 1360 Cm^{-1}.

2d: ^{1}HNMR δ (acetone d_6): 6.35 (d, 1H, olefinic CH), 7.1–7.75 (m, 3H, aromatic protons), 7.8 (d, 1H, olefinic CH), IR, ν (KBr disc): 1720, 1620, 1560, 1345 Cm^{-1}.

2e: ^{1}HNMR δ (acetone d_6): 6.3 (d, 1H, olefinic CH), 7.2–7.75 (m, 3H, aromatic protons), 7.85 (d, 1H, olefinic CH), IR, ν (KBr disc): 1720, 1630, 1555, 1360 Cm^{-1}.

2f: ^{1}HNMR δ (acetone d_6): 4.25 (s, 3H, OMe), 6.4 (d, 1H, olefinic CH), 7.1–7.8 (m, 3H, aromatic protons), 7.9 (d, 1H, olefinic CH), IR, ν (KBr disc): 1715, 1620, 1565, 1350 Cm^{-1}.

REFERENCES

[1] R. O'Kenedy and R. D. Thornes, *Coumarins: Biology, Applications and Mode of Action* (Willey & Sons, Chichester, 1997).

[2] a) S. Kadis, A. Ciegler, and S. Ajl, *Meorev.* **7** (1972) ch. 1; b) G. P. Ellis and G. B. West, *Plwg. Med. Chem.*, **10,** 109 (1974); c) P. Wells and H. Mossison, *J. Am. Chem. Soc.*, **97,** 154 (1975).

[3] S. Kadis, A. Ciegler, and S. Ajl, *Meorev*, **7** (1972) Ch. 1.

[4] a) H. Takashi, K. Keiko, N. Hiromi, F. Masako, N. Yoshitaka, and I. Hisashi, *Heterocycles*, **39,** 613 (1994); b) H. Takashi, N. Kazimitsu, N. Hiromi, M. Kioko, O. Yokiko, T. Yasuo, I. Hisashi, and K. Kazuhiro, *Heterocycles*, **38,** 2729 (1994).

[5] a) G. Wittig and W. Hagg, *Chem. Ber.*, **88,** 1654 (1955); b) V. F. Kucherov, B. G. Kavalev, I. I. Kazaova, and L. A. Yanovaskaya, *Izv. Akad. Nauk. S.S.S.R.*, *Otdel. Khim. Nauk*, 1512 (1960); *Chem. Abstr.*, **55,** 1420b (1961).

[6] a) R. D. H. Murray and S. A. Brawn, *The Natural Coumarins* (Wiley & Sons, New York, 1982), pp. 131–136; b) J. D. Hepworth, *Comprehensive Heterocyclic Chemistry*, edited by A. R. Katritzky, C. W. Ress, A. J. Boulton, and A. Mckillop (Pergamon Press, Oxford, 1984), vol. 3, pp. 799–809.

[7] a) A. McKillop and D. W. Young, *Synthesis*, 401 (1979); b) P. Laszlo, *Acc. Chem. Res.*, **19,** 121 (1986).

[8] a) A. Shockravi, H. Valizadeh, and M. M. Heravi, *Phosphorus, Sulfur, and Silicon*, **177**(12), 2835–2841 (2002); b) A. Shockravi, H. Valizadeh, and M. M. Heravi, *Phosphorus, Sulfur, and Silicon*, **178**(1), 143–147 (2002); c) M. M. Heravi, D. Ajami, K. Aghapoor, and M. Ghassemzadeh, *J. Chem. Soc. Chem. Commun.*, 833 (1999); d) M. M. Heravi, D. Ajami, M. M. Mojtahedi, and M. Ghassemzadeh, *Tetrahedron Lett.*, **40,** 561 (1999).

[9] J. Villieras, M. Ramband, and M. Graft, *Tetrahedron Lett.*, **26,** 53 (1985).

[10] F. D. Cramer and H. Windel, *Chem. Ber.*, **89,** 354 (1956).

[11] G. T. Morgan and F. M. G. Micklethwait, *J. Chem. Soc.*, **85,** 1230 (1904).

[12] N. Oda, Y. Yoshida, S. Najai, T. Ueda, and J. Sakakibara, *Chem. Pharm. Bull.*, **35,** 1796 (1987).

[13] H. Takashi, N. Kazimitsu, N. Hiromi, M. Kioko, O. Yokiko, T. Yasuo, I. Hisashi, and K. Kazuhiro, *Heterocycles*, **38,** 2729 (1994).

[14] R. S. Mali, V. J. Vadav, and R. N. Zavane, *Ind. J. Chem.*, **21B,** 759 (1982).