J. Chem. Research (S),
2003, 603–604
J. Chem. Research (M),
2003, 1001–1013

Useful synthesis of aryl cinnamates: synthesis of difengpin

Raghao S. Mali[a,b]* and Abhijit S. Papalkar[a]

[a]Garware Research Centre, Department of Chemistry, University of Pune, Pune-411007, India

[b]Present Address: North Maharashtra University, P.B.No-80, Jalgaon- 425001, India

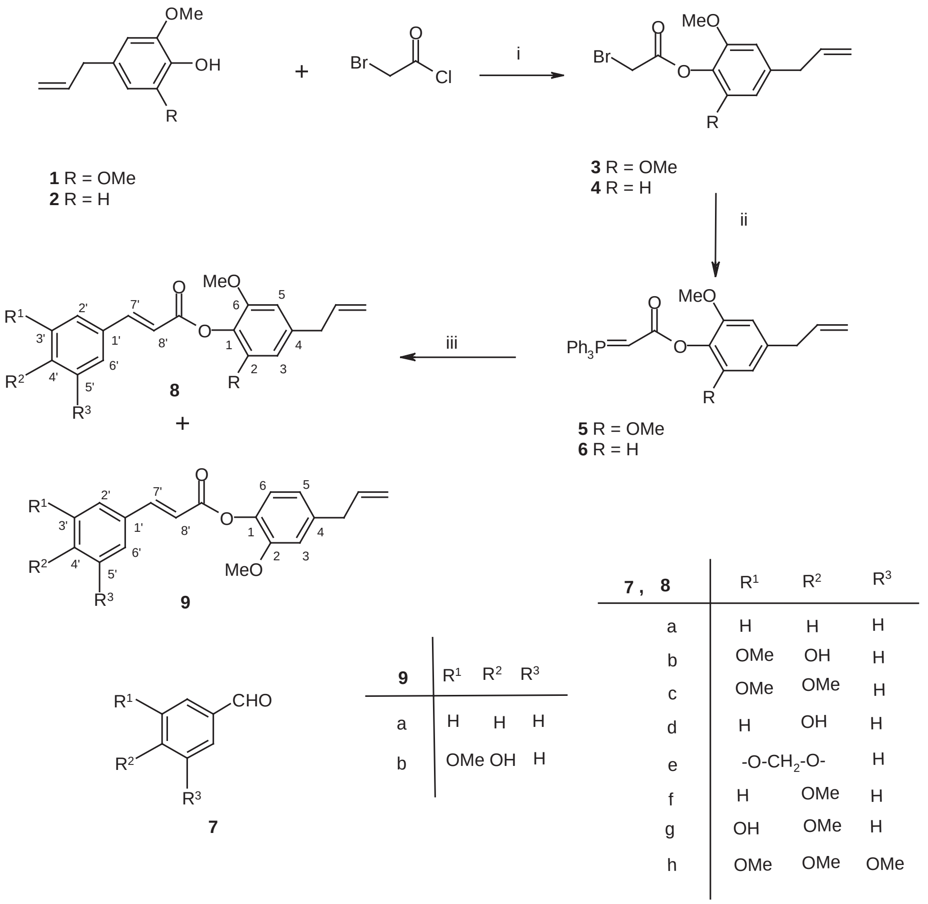
A convenient, high yield and general method is described for the synthesis of difengpin (**8a**) and aryl cinnamates (**8b–h** and **9a,b**) from benzaldehydes (**7a–h**).

Keywords: aryl cinnamates, difengpin

Difengpin (**8a**), an aryl cinnamate has been isolated[1] in 1997 from *Illicium difengpi* K.I.B and K.I.M. belonging to Magnoliaceae family. This plant is mainly distributed in Guangxi Zhuang region of China. In the Chinese pharmacopaeia the dried bark of *Illicium difengpi* is recorded as anti-rheumatic drug for relieving lumbago and pain in the knees.[1] The structure of difengpin (**8a**) was established[1] on the basis of IR, ^{1}H NMR, ^{13}C NMR and mass spectral data. The structure **8a** was also supported by the ^{1}H-^{13}C COSY and HMBC measurements.

Various aryl cinnamates are reported[2] to possess anti-cancer and anti-inflammatory activity. 4-Allyl-2-methoxyphenylcinnamate (**9a**) and 4-allyl-2-methoxyphenylferulate (**9b**) are reported to show anti-fungal activity against *Pythium* species.[3] 4-Allyl-2-methoxyphenylcinnamate (**9a**) also exhibits anti-alopecic activity.[4] Aryl cinnamates also have industrial applications as they are reported[5] to possess liquid crystal properties. Aryl cinnamates have also been used for the synthesis of flavanones,[10] cinnamoyl coumaranones,[11] 2-styryl chromones,[12] styryl pyrazoles.[12] and stilbenes.[13] $AlCl_3$ catalysed reaction of aryl cinnamates in chlorobenzene leads to the formation of coumarins.[15] 2-Iodoaryl cinnamates on reaction with $SnBu_3H$ and AIBN in benzene give substituted benzofuranones.[16]

In view of the natural occurrence and synthetic utility, various methods have been reported for the synthesis of aryl cinnamates. The classical method involves the reaction of acid chlorides with phenol in the presence of pyridine.[5] The methods involving condensation of cinnamic acid, with phenol in presence of dicyclohexylcarbodiimide[17] (DCC) or diethyl phosphorocyanidate (DEPC) and triethylamine[4] give aryl cinnamates.



9	R¹	R²	R³
a	H	H	H
b	OMe	OH	H

7 , 8	R¹	R²	R³
a	H	H	H
b	OMe	OH	H
c	OMe	OMe	H
d	H	OH	H
e	-O-CH$_2$-O-		H
f	H	OMe	H
g	OH	OMe	H
h	OMe	OMe	OMe

Scheme 1 Reagents and conditions: (i) Pyridine, CH_2Cl_2, 0°C; (ii) PPh_3, C_6H_6, rt, (NaOH); (iii) CH_2Cl_2,rt, 3-6h

---

* To receive any correspondence. E-mail: rsmali@rediffmail.com

We wish to report here a simple method (Scheme 1) for the preparation of difengpin (**8a**) and other aryl cinnamates having an allyl chain. Our method involves the reaction of phosphoranes **5** and **6** with different aldehydes (**7a–h**) and provides the corresponding aryl cinnamates (**8a–h** and **9a–b**) in good yield. The phosphorane **5** when reacted with benzaldehyde (**7a**) in dichloromethane at room temperature, difengpin (**8a**), m.p. 153–155°C (lit[1].m.p.153-155 °C) in 68 % yield. The ***E***- configuration of **8a** was clearly established on the basis of the ^{1}H NMR spectral data. Thus, the coupling constant of the olefinic 7'-and 8'- protons, which appeared as doublets at δ_H7.92 and 6.76 respectively, was found to be 16.3 Hz. The ^{1}H NMR and ^{13}C NMR spectral properties exhibited by **8a** are in good agreement with those reported[1] for the natural product. The phosphorane **5** on similar reaction with aldehydes (**7b–h**) in dichloromethane at room temperature gave the corresponding aryl cinnamates (**8b–h**) in 62–85 % yield.

Aryl cinnamates (**9a** and **9b)**, having allyl chain, are reported to possess antifungal[3] and antialopecic[4] activity. The synthesis of these compounds has also been achieved using the present approach. The phosphorane **6** required for this purpose was prepared from eugenol. The phosphorane **6** on reaction with benzaldehyde (**7a**) and vanillin (**7b**) gave the corresponding esters **9a** and **9b** in 88 and 75% yield respectively. On the basis of their ^{1}H NMR spectral properties all the products **8a–h** and **9a–b** were found to be *E*-isomers. The olefinic 7'- and 8'- protons of these compounds appeared as doublets ($J \sim 16$ Hz) at δ_H ~7.8 and ~6.6 respectively

In conclusion, a high yield, general method has been reported here for the synthesis of aryl cinnamates (**8a–h**) including the natural product, difengpin (**8a**) and the biologically active cinnamates **9a** and **9b**. The novelty of the present method is that the products are formed at room temperature, under neutral conditions without isomerisation of the double bond in allyl chain.

We thank Mrs J.P. Chaudhari, Mr. A.P.Gadgil for spectral and analytical data. One of us (ASP) thanks CSIR New Delhi for the award of Senior Research Fellowship.

Techniques used: IR, ^{1}H NMR, ^{13}C NMR, mass, elemental analysis, TLC and column chromatography.

References: 20

Schemes: 1

Received 12 April 2003; accepted 12 September 2003
Paper 03/1863

References cited in this synopsis

1 P. Huang, M. Yang, M. Lai, X. Zheng, M. Nishi and T. Nakanishi, *J. Chin. Pharm. Sci*., 1997, **6**, 129.
2 L.P. Zhang and Z.Z. Ji, *Yaoxue Xuebao*, 1993, **21**, 817; *Chem. Abstr.* 1993, **118**, 212590x.
3 S. Tawata, S. Taira, N. Kobamota, J. Zhu, M. Ishihara and S. Toyama, *Biosci. Biotech. Biochem*., 1996**, 60**, 909.
4 J.S. Shin, J.H. Kim, J.H. Park, E-D. Son, H-G. Park, and B-K. Kim, *Soul Taehak. Yakh. Nonmu.*,1996, **21**, 1; *Chem. Abstr.* 1999,**130,** 76142w.
5 J.S. Dave and K.P. Dhake, *Bull. Chem. Soc. Jpn*., 1992, **65**, 559.
10 F.M. Moghaddam, M.G. Ghaffarzadeh and S.H. Abdi-Oskoui S., *J Chem Res. (S),* 1999, 574.
11 K.S. Khanna, C.P. Garg and R.P. Kapoor, *Org. Prep. Pro. Int* 1992, **24**, 469.
12 C.G.A. Pinto, A.M.S. Silva and J.A.S. Cavaleiro, *Tetrahedron*, 1999, **55**, 10187.
13 W. Chamchaang, N. Chantarasiri, S. Chaona, C. Thebtaranonth and Y. Thebtaranonth, *Tetrahedron*, 1984, **40**, 1727
15 T. Manimaran and V.T. Ramkrishnan, *Ind. J. Chem*., 1979, **18B**, 324.
16 K. Shankaran, C.P. Sloan and V. Snieckus, *Tetrahedron Lett*. 1985, **26**, 6001.
17 N.S. Isaacs and T.S. Najem, *J. Chem. Soc. Perkin. Trans. 2*. 1988, 557.