

## Reaction of *O*-Silylated Enolates of Carboxylic Esters with Benzyne. A Convenient Route to *ortho*-Alkylbenzoic Acids

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The reaction of *O*-silylated enolates of carboxylic esters with benzyne proceeds smoothly to afford *ortho*-alkylbenzoic acids in moderate yields.

A variety of reactions using *O*-silylated enolates (**1**) of carboxylic esters have been documented.<sup>1</sup> In most cases, the nucleophilicity of their  $\alpha$ -carbon causes the reactions with numerous electrophiles. Also, in a few cases, the formation of an intermediate radical containing trivalent  $\alpha$ -carbon has been proposed.<sup>2</sup> Here we report a novel reaction in which the compounds (**1**) participate. Thus, compounds (**1**) were allowed to react with chloro- or bromo-benzene in the presence of excess  $\text{NaNH}_2$  at room temperature providing *ortho*-alkylbenzoic acids (**2**) in moderate yields. It is clear that the reaction proceeded *via* a process involving the initial formation of benzyne and its subsequent addition to (**1**) affording intermediate bicyclic compounds which were hydrolysed during the work-up procedure.

An *O*-silylated enolate (**1**) (10 mM) of carboxylic ester was mixed with chlorobenzene (1.13 g, 10 mM) [or bromobenzene (1.57 g, 10 mM)] and  $\text{NaNH}_2$  (1.17 g, 30 mM). The mixture was stirred under a nitrogen atmosphere for 24 h at room temperature. It was treated with cold water (30 ml) and extracted with dichloromethane (3  $\times$  50 ml). The organic extract was washed with water, dilute aqueous HCl (10%), and again with water, dried over anhydrous  $\text{MgSO}_4$ , and then the solvent was evaporated under reduced pressure to afford a residue which was subjected to column chromatography on silica gel (50% ethyl acetate-hexane as eluent). The results are summarized in Table 1.

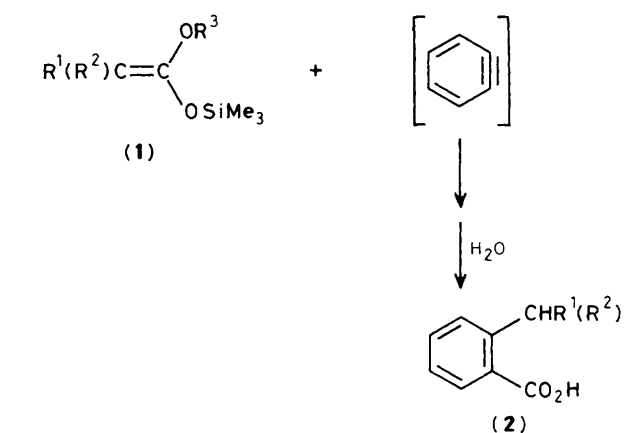
To our knowledge, several synthetic methods of *ortho*-alkylbenzoic acids are now available. Among these, the procedure involving the reaction of 3-alkyl- or 3,3-dialkylphthalides with HI in the presence of phosphorus seems to be

the most general method.<sup>6,7</sup> As a result, the former 3-alkylphthalides are easily available and the latter 3,3-dialkylphthalides seem to be prepared using the appropriate Grignard reagents and *ortho*-acylbenzoic acids<sup>8</sup> (or diethyl phtha-

**Table 1.** Reaction of *O*-silylated enolates (**1**) of carboxylic esters with benzyne.

Substrate	Benzyne source	Product	
		% Yield <sup>a</sup>	M.p. (°C) <sup>b</sup> (lit. m.p.)
( <b>1a</b> )	PhCl	( <b>2a</b> )	40 62 (64–65) <sup>3</sup>
( <b>1a</b> )	PhBr	( <b>2a</b> )	42
( <b>1b</b> )	PhCl	( <b>2b</b> )	40 150–152 (155–158) <sup>4</sup>
( <b>1b</b> )	PhBr	( <b>2b</b> )	41
( <b>1c</b> )	PhCl	( <b>2c</b> )	42 58–61 (64) <sup>3</sup>
( <b>1c</b> )	PhBr	( <b>2c</b> )	46
( <b>1d</b> )	PhCl	( <b>2d</b> )	51 108
( <b>1d</b> )	PhBr	( <b>2d</b> )	50
( <b>1e</b> )	PhCl	( <b>2e</b> )	39 64–65 (64–65) <sup>5</sup>
( <b>1e</b> )	PhBr	( <b>2e</b> )	37
( <b>1f</b> )	PhCl	( <b>2f</b> )	47 123–124
( <b>1f</b> )	PhBr	( <b>2f</b> )	50

<sup>a</sup> Isolated yield by column chromatography. <sup>b</sup> Recrystallized from hexane.



	R <sup>1</sup>	R <sup>2</sup>	R <sup>3</sup>		R <sup>1</sup>	R <sup>2</sup>	R <sup>3</sup>
a;	H	Me	Et	d;	Me	Et	Et
b;	H	Et	Et	e;	H	Pr <sup>i</sup>	Et
c;	Me	Me	Et	f;	Et	Et	Et

Scheme 1

late<sup>3</sup>). However, the present method is more easily conductable than the other methods reported. Thus, the reaction of (1) with benzyne has been shown to provide an excellent alternative route to (2). Detailed study on the mechanism as well as the applicability of the present method to another *O*-silylated enolates and arynes is in progress.

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