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A one-pot procedure for the synthesis of iodoalkynes from aldehydes

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Abstract

Iodoalkynes R-C≡CI were obtained in good yield through a one-pot procedure by reaction of the aldehydes RCHO with diiodomethyltriphenylphosphorane first generated in situ from iodoform, triphenylphosphine and *t*-BuOK. © 1999 Elsevier Science Ltd. All rights reserved.

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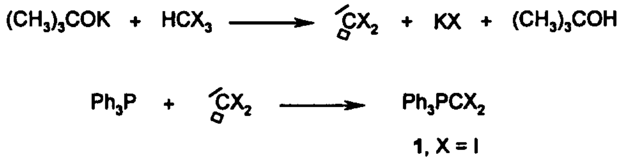
In the preceeding communication,[1] we reported the facile conversion of aldehydes to dibromoalkenes and alkynes. The intermediate bromoalkynes could not always be obtained. In this communication, we describe a similar one-pot procedure for the conversion of aldehydes to iodoalkynes, which are useful and versatile reagents.[2]

In order to achieve a one-pot procedure, the same solvent should be used along the different stages of this conversion. Wittig-type reactions have already been reported for the first step: diiodomethyltriphenylphosphorane **1** obtained[3] from CI_4 and PPh_3, but in CH_2Cl_2, or diethyl diiodomethylphosphonate[4] have both been used. It seemed to us that the preparation of the phosphorane **1** could be simplified by adapting a procedure described by Speziale[5] for the formation of dihalomethyltriphenylphosphoranes from chloroform or bromoform (Scheme 1).



$$(CH_3)_3COK + HCX_3 \longrightarrow :CX_2 + KX + (CH_3)_3COH$$

$$Ph_3P + :CX_2 \longrightarrow Ph_3PCX_2$$

1, X = I

Scheme 1. Speziale's method

To our surprise, we could not find any literature reference to this reaction with iodoform. However, **1** was very easily generated by this method from these readily accessible commercial reagents. Furthermore, there is no superfluous formation of by-products such as PPh_3I_2.[3]

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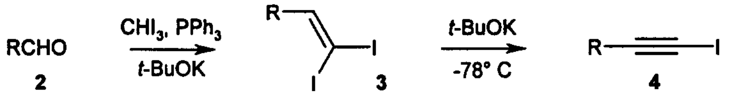
When solid CHI_3, PPh_3 and *t*-BuOK were dissolved simultaneously in THF under argon, the solution immediately became brown.[6] When an aldehyde **2** (see Scheme 2 and Table 1) was added, the 1,1-diiodoalkene **3** was formed and could be obtained in good yield after addition of brine[7] (Table 1). By this method, **3b**, not obtained when the ylide **1** was generated from CI_4 and PPh_3,[3] was easily prepared. In order to prepare the corresponding iodoalkyne **4**, the reaction was not quenched at the diiodoalkene stage, and five to six equivalents of *t*-BuOK were added to the THF solution at −78°C. The iodoalkynes **4** could then be isolated in good yield (Table 1).



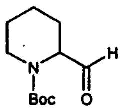
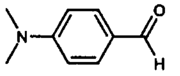
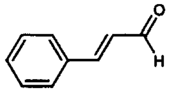
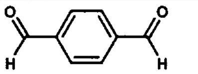
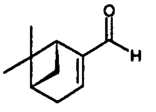
Scheme 2.

Compared to the reactions with dibromomethylenetriphenylphosphorane reported in the preceeding paper, where bromoalkynes such as those deriving from **2b** and **2d** were too rapidly reduced at −78°C to be isolated, the aryl-substituted iodoalkynes **4b** and **4d** were easily obtained. In fact, the reaction of a diiodoalkene with base could be selectively oriented either to the iodoalkyne or to the terminal alkyne by choosing the appropriate temperature, which was eventually found to vary with the substrate. For instance, with 7-methoxy-3,7-dimethyloctanal **5**, the three different derivatives **6**, **7** and **8** (Table 2) were obtained by adding *t*-BuOK to the reaction mixture at three different temperatures.

In summary, diiodomethyltriphenylphosphorane **1** can easily be generated in an extension of Speziale's method, thus allowing the preparation of iodoalkynes in good yield in a single-pot procedure.

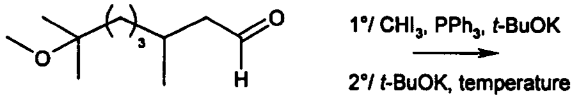
General procedure for the preparation of iodoalkynes: THF (20 mL) was added to iodoform (4.2 mmol), triphenylphosphine (4.4 mmol) and *t*-BuOK (4 mmol) under argon atmosphere. The mixture was stirred at room temperature, and after one minute, the aldehyde (2 mmol) (dissolved in THF if necessary) was added. After 15 min, this solution was cooled to −78°C and *t*-BuOK (10 mmol) was added. After an additional 15 min,[8] this solution, still maintained at −78°C, was quenched with brine (30 mL) and after returning to room temperature, extracted twice with ether (30 mL). The organic layers were dried

Table 1

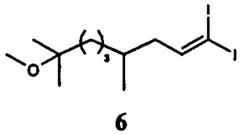
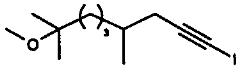
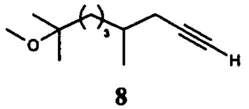
	2	3, yield (%)$^{(a)}$	4, yield (%)$^{(a)}$
a		80	96
b		80	80
c			96
d			75$^{(b)}$
e			83

(a) Isolated yield; (b) two equivalents of ylide were used

Table 2



5

Temperature	Reaction product	Yield (%)[(a)]
-78° C	 6	80
-50° C	 7	97
rt	 8	81

(a) Isolated yield

over Na_2SO_4 and concentrated. Chromatography on silica gel afforded the corresponding iodoalkyne, identified through their ^{13}C NMR spectra.[9]

References

1. Preceeding communication: Michel, P.; Gennet, D.; Rassat, A. *Tetrahedron Lett.* **1999**, *40*, 8575–8578.
2. See for instance, the addition on aldehydes of chromium acetylides obtained from iodoalkynes and $CrCl_2$: Takai, K.; Kuroda, T.; Nakatsukasa, S.; Oshima, K.; Nozaki, H. *Tetrahedron Lett.* **1985**, *26*, 3769–3772, or the preparation of *cis* iodoaalkenes: Zweifel, G.; Arzoumanian, H. *J. Am. Chem. Soc.* **1967**, *89*, 5086–5088.
3. (a) Gavina, F.; Luis, S. V.; Ferrer, P.; Costero, A. M.; Marco, J. A. *J. Chem. Soc., Chem. Commun.* **1985**, 296–297. (b) Gavina, F.; Luis, S. V.; Ferrer, P.; Costero, A. M.; Marco, J. A. *J. Chem. Res.* **1986**, 330–331. (c) Gavina, F.; Luis, S. V.; Ferrer, P.; Costero, A. M.; Marco, J. A. *J. Chem. Res.* **1986**, 2843–2853.
4. This reagent had already been used for the synthesis of two iodoalkynes in a one-pot procedure: Bonnet, B.; Le Gallic, Y.; Plé, G.; Duhamel, L. *Synlett* **1993**, 1071–1073.
5. (a) Speziale, A. J.; Marco, G. J.; Ratts, K. W. *J. Am. Chem. Soc.* **1960**, *82*, 1260. (b) Speziale, A. J.; Ratts, K. W. *J. Am. Chem. Soc.* **1962**, *84*, 854–859. (c) Raulet, C.; Levas, E. *Bull. Soc. Chim. Fr.* **1971**, 2598–2606. (d) McIntosh, M. C.; Weinreb, S. M. *J. Org. Chem.* **1991**, *56*, 5010–5012.
6. In a similar reaction with $CHBr_3$, the THF solution became black as Ph_3PCBr_2 was formed, while yellow-brown solutions were observed (see Ref. 1) when this reagent was generated from dibromomethyltriphenylphosphonium bromide.
7. Here again (see Ref. 1), it is important to quench the reaction with a saturated NaCl solution.
8. It may be necessary at this stage to check that **3** has been effectively converted to **4**. If not, different higher temperatures should be tested.
9. **4a** ($CDCl_3$, 50 MHz): –0.4, 19.9, 25.0, 28.2, 30.4, 40.3, 45.8, 79.8, 92.6, 154.1; **4b** ($CDCl_3$, 50 MHz): 1.7, 40.1, 95.0, 110.1, 111.4, 133.3, 150.2; **4c** ($CDCl_3$, 50 MHz): 8.1, 93.4, 108.1, 126.3, 128.8, 128.9, 135.4, 143.4; **4d** ($CDCl_3$, 50 MHz): 21.0, 92.1, 123.2, 132.1; **4e** ($CDCl_3$, 50 MHz): 5.0, 20.8, 25.7, 31.1, 31.6, 37.6, 39.8, 46.5, 94.5, 130.2, 132.9; **7** ($CDCl_3$, 50 MHz): –6.9, 19.4, 21.2, 24.9, 28.1, 32.6, 36.5, 39.9, 49.0, 74.5, 93.6.