

CONVENIENT PREPARATION OF BROMOALKYNES FROM PRIMARY ALKYNES AND PPh₃ / CBr₄

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Summary: 1-Bromo-1-alkynes are prepared in high yields under very mild conditions by treatment of primary alkynes with PPh₃/CBr₄.

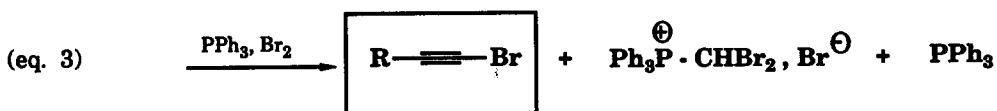
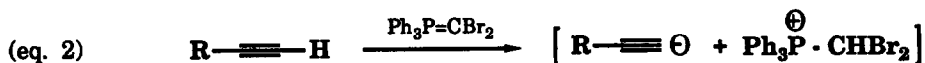
1-Halo-1-alkynes are versatile intermediates in organic synthesis (1-10). They are commonly obtained by reaction of deprotonated primary alkynes with bromine or by addition of bromine to triple bonds, followed by a dehydrohalogenation with bases (11-20). In the first procedure, strong bases (butyl lithium, ethyl magnesium or



sodium hydroxide) are used for the deprotonation of the primary alkyne which are unsuitable for many sensitive functional groups. In the second procedure, the use of bromine and base precludes also several sensitive functionalities.

Attempts in our laboratory to directly transform sensitive polyfunctional alkynes into the corresponding bromoalkynes, using available methods, resulted in low yields and untractable product mixtures. Therefore, we sought an alternative approach and report herein an efficient procedure.

Recently, we reported that PPh_3/Br_2 or $\text{PPh}_3/\text{CBr}_4$ are efficient reagents for the transformation of THP ethers directly into bromides, for the cyclisation of ketals, and the selective deprotection of alcohols (21-23). Herein, we report that $\text{PPh}_3/\text{CBr}_4$ is able, to convert polyfunctional primary alkynes into the corresponding bromides under very mild conditions (methylene chloride at room temperature) and with excellent yields. We postulate the following sequence of reactions: the addition of two equivalents of PPh_3 and one equivalent of CBr_4 leads to an equimolar mixture of PPh_3/Br_2 and dibromomethylene triphenyl phosphine ylid (24). (eq.1)



This ylid deprotonates the primary alkyne to form a phosphonium salt (eq.2) which is brominated with triphenyl phosphine dibromide (eq.3).



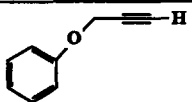
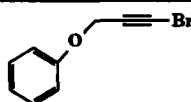
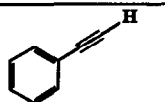
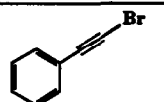
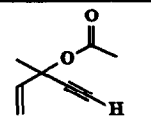
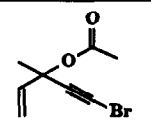
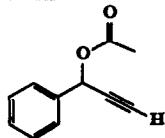
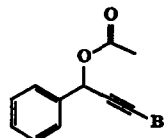
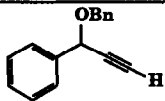
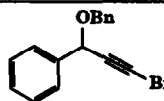
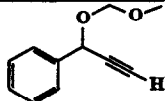
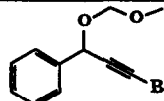


When only one equivalent of PPh_3 is used, the rate of the reaction is much slower.

This mechanism is consistent with the observation that the primary alkynes are stable toward PPh_3/Br_2 alone.

These very mild reaction conditions are compatible with the presence of ester groups, double and triple bonds, benzylic, propargylic and allylic ethers, MOM acetals... (see table) and in these conditions, triphenylphosphine does not react with the bromoalkyne (25).

In a typical procedure, the primary alkyne (1 mmol), and CBr_4 (3 mmoles) are dissolved in 2 ml of anhydrous methylene chloride under argon. PPh_3 (6 mmoles) are added at room temperature and the reaction is monitored by TLC. After the disappearance of the alkyne, ether is added in order to precipitate the phosphonium salt; filtration and silicagel column chromatography lead to the pure compounds in 92-96% yields.

1-Bromo-1-alkynes

Entry	Substrate	Product**	Time	Yield*
1			7 h	93 %
2			15 min	95 %
3			90 min	96 %
4			20 min	92 %
5			2 h	96 %
6			1 h	92 %
7			30 min	95 %
8			10 h	—

* Yields of isolated products

** All compounds were characterised by i.r., ^1H and ^{13}C n.m.r. and microanalysis.

References and notes

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