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THE HYDROALUMINATION OF ω-TERBUTOXY ALKYNES AN EASY ACCESS TO ω-HYDROXY ALKENYL IODIDES APPLICATION TO THE SYNTHESIS OF DIENIC INSECT PHEROMONES

A. ALEXAKIS*, J.M. DUFFAULT**

* Laboratoire de Chimie des Organo-éléments, tour 45
Université P. et M. Curie, 4 place Jussieu F-75252 PARIS Cédex 05

** Laboratoire des Médiateurs Chimiques, Domaine de Brouessy
Magny les hameaux F-78470 Saint-Rémy-lès-Chevreuse

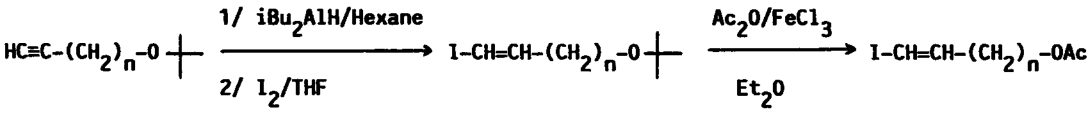
Summary - In contrast to classically protected ω-hydroxy alkynes, ω-terbutoxy alkynes undergo smooth hydroalumination with DIBAL-H. The obtained E or Z alkenyl alanes are iodinated leading to E or Z alkenyl iodides. The ω-terbutoxy group is easily converted into an acetate. The latter compounds are useful synthons for the synthesis of insect pheromones as examplified with two cases.

The protection of alcohols as terbutyl ethers has scarcely been used in organometallic synthesis, for the simple reason that this protection is difficult to remove. However we have already pointed out the great advantages of ω-terbutoxy Grignard or organolithium reagents (as compared to their ω-tetrahydropyranyloxy or ω-silyloxy conterparts, for example) in their high yielding preparation and their normal reactivity[1,2]. We have also reported recently the easy and mild cleavage of terbutoxy ethers into the corresponding acetates[2]. We wish to report herein the use of the terbutyl ether protection in organoaluminum chemistry.

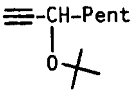
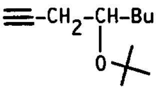
It is long known that the hydroalumination of terminal alkynes cannot efficiently be performed with ω-alkynols, either protected or not[3]. The presence of an oxygenated functionality (a Lewis base) in this reaction, which is run in hydrocarbon solvent, strongly affects the reactivity of diisobutyl aluminum hydride (a Lewis acid). Two ways have been disclosed to circomvent these difficulties. Zweifel et al have used 1-trimethyl silyl alkynes, instead of terminal alkynes[3g], the silicon group being removed after the reaction, in a second step. On the other hand, we have used, in pheromone synthesis, instead of an oxygen functionality, a halogen atom which does not impede the hydroalumination reaction. The halogen serves for an ω-functionalisation in a further step of the synthesis[4].

We have now found that an ω-terbutoxy functionality is too weak a Lewis base to impede the hydroalumination reaction. The examples shown in the table are performed on preparative scale (0.1-0.5 mol) under exactly the standard and classical experimental conditions[5] and the resulting alkenyl alane is iodinated *in situ* . In all cases, the isolated yield of distilled alkenyl iodide fell into the usual range for the same reaction with non-functionalized alkynes.

Table -



A B

Entry	Alkyne n	Yield of A[a] %	Stereochemistry[b]	Yield of B[c] %
1	1	62	Z >99%	d
2	2	74	Z >99%	d
3	3	72	E : 96%	d
4	4	73	E > 99%	d
5	6	62	E >99%	89
6	8	62	E >99%	87
7	10	66	E >99%	89
8		67	Z >99%	76[e]
9		76	Z >99%	93

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a : Yield of the product isolated by distillation

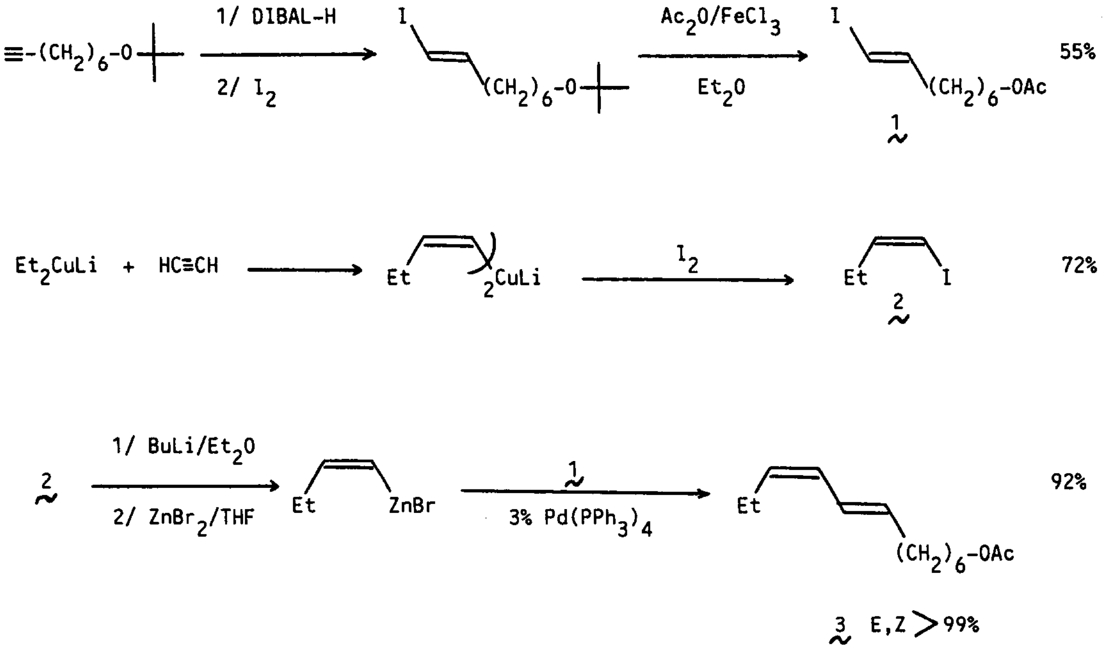
b : Attributed by ^1H and ^{13}C NMR. The purity is determined by capillary gas chromatography (OV 101)

c : Isolated by either distillation or flash column chromatography

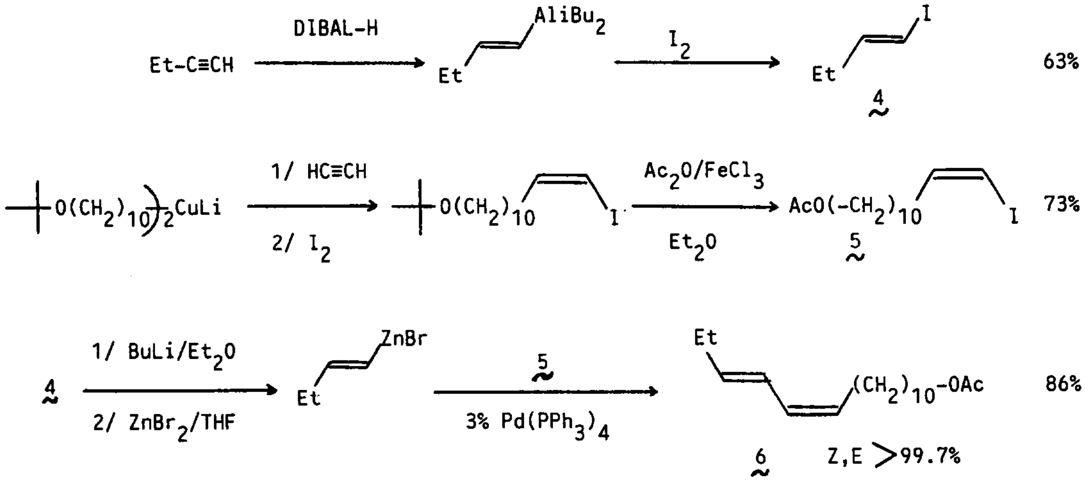
d : The cleavage into acetate was not performed

e : Yield of the alcohol obtained after hydrolysis of the ester group

The stereochemistry of the hydroalumination is purely *syn* only when the terbutoxy group is in a position where an intramolecular chelate is disfavored (n $\geqslant$ 3). However, when the terbutoxy group is in propargylic (n=1) or homopropargylic position (n=2), a five or six membered chelate induces an exclusive *anti* hydroalumination (entries 1, 2, 8, 9)[6].
Most of the above ω-terbutoxy alkenyl iodides have been cleaved into the corresponding acetates under mild conditions[2], without any loss of the stereoisomeric purity. Z-Alkenyl iodides having an allylic functionality (entries 1 and 8) are usually prepared by $LiAlH_4$ reduction-iodination of propargylic alcohols[7]. However the same Z-iodides having a homoallylic functionality (entries 2 and 9) are difficult to obtain otherwise[8]. On the other hand E-alkenyl iodides are very useful synthons in organic synthesis and particularly in the insect pheromone field. In this context, it should be pointed out that the hydroalumination reaction which affords E-alkenyl iodides (functionalized or not) is complementary to the carbocupration reaction[9], which leads to the corresponding Z-alkenyl iodides. By combining both methods it is possible to prepare any pheromone having an E,Z conjugated diene system. This complementarity is illustrated by the synthesis of (E,Z)-7,9-dodecadienyl acetate 3, the Grape-vine moth (*Lobesia botrana*) pheromone, which associates the hydroalumination of a functionalized alkynes and the carbocupration with a non-functionalized cuprate :



On the other hand, the synthesis of (Z,E)-11,13-hexadecadienyl acetate 6[10], is performed through the reverse process.



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