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2,2-Di(ethoxy)vinyllithium: Reactions with Carbonyl Compounds

Abdelaziz Hiouni and Lucette Duhamel*

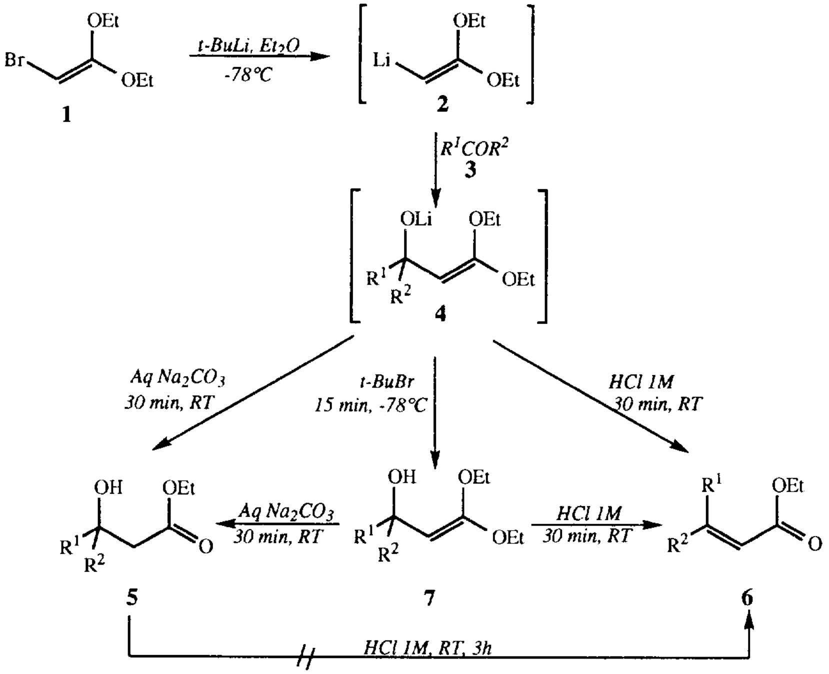
Université de Rouen , Unité de Recherche Associé au CNRS, Faculté des Sciences et Institut de Recherche en Chimie Organique Fine (IRCOF) F-76821 Mont-Saint-Aignan (France)

Abstract: 2,2-Di(ethoxy)vinyllithium **2** generated from bromo ketene acetal **1** reacts with carbonyl compounds to give either β-hydroxy esters **5** or conjugated esters **6** or hydroxy ketene acetals **7** according to the work up. Copyright © 1996 Published by Elsevier Science Ltd

Although known since 1937, 2-bromo-1,1-diethoxyethylene **1**[1] was only recently used as precursor of 2-lithio-1,1-diethoxyethylene **2**, a synthetic equivalent of ethyl acetate anion.[2,3] The recent publication of Wei and Schlosser[2] relating the preparation of anion **2** from **1** and its reaction with various electrophilic reagents incites us to report our own results, concerning the same preparation of anion **2** and its reaction with carbonyl compounds.[3]

Treating bromo ketene acetal **1** with *tertio*-butyllitium in ether or THF at -78°C affords a bromine-lithium exchange and the obtained lithio diethoxyethylene **2** was *in situ* condensed with carbonyl compounds **3**. We show that the resulting adducts **4** are transformed in good yields into either β-hydroxy esters **5** or α,β-ethylenic esters **6** or hydroxy ketene acetals **7**, according to the work-up conditions (table 1).

Reaction of adducts **4** with aqueous Na_2CO_3 at RT leads to β-hydroxy-esters **5** whereas treating with HCl 1M at RT, directly provides unsaturated esters **6**. Control experiments showed that hydroxyesters **5** were not intermediates in the transformation **4** to **6** : they were retrieved unchanged when submitted to the mild acidic conditions used for this last reaction. Protonation of the adducts **4** occurs by addition of *tertio*-butyl bromide: after separation of the lithium salts by centrifugation, the crude hydroxy ketene acetals **7** were isolated in a pure form. Other attemps using aqueous NaOH, various carboxylic acids or alcohols instead of *tertio*-butyl bromide led to a partial transformation into esters **5** or **6**. Obviously compounds **7** were converted into either hydroxy esters **5** or ethylenic esters **6** when submitted to conditions used for reactions **4** to **5** or **4** to **6**. They were also transformed into ethylenic esters **6** by chromatography on silicagel.

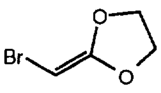


The results of table 1 show that anion **2** reacts with ketones as well as with aldehydes, with crowed (**3b,d,g**) and very enolisable compounds such as cyclopentanone **3f**. With unsaturated carbonyl compounds **3** the condensation occurs exclusively in 1,2. Ethylenic esters **6** were isolated with a pure E configuration starting from aldehydes whereas a mixture of Z, E isomers was generally obtained from unsymetrical ketones.

Also to be noted the reaction with dimethyl cyclopentanone **3g** leading to the sole conjugated E ester **6g** precursor of the pheromone polyzonimine while the Wittig-Horner condensation was reported to give a mixture of three products: Z, E and deconjugated isomeric esters.[4] As the dehydration of β-hydroxy esters **5b** and **5e** of the terpenic series has been reported to lead to deconjugated esters[5,6], the direct transformation of carbonyl compounds **3** into conjugated esters **6** without any trace of deconjugated esters presents a great interest.

Thus reagent **2** is an alternative to other classical reagents for the transformations **3** to **5** (Reformatsky reagent[7], Meyers lithio oxazolidine[8], ethyl lithio acetate[9]) and **3** to **6** (ethoxy carbonyl triphenyl phosphorane[10], triethyl phosphonoacetate anion [11], ethyl lithio trimethylsilyl acetate [12]).

We obtained similar results from the cyclic bromo ketene acetals **8 a-d**.



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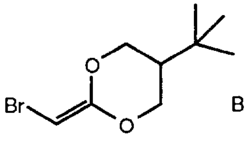

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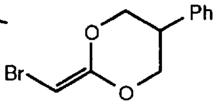

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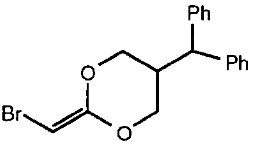
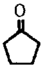
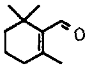
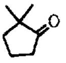
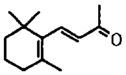
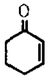


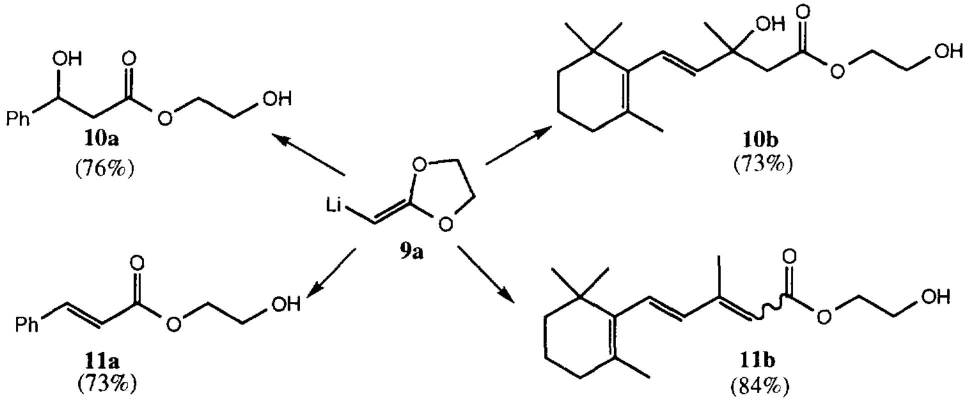
8d

Table 1: *Reaction of carbonyl compounds* **3** *with anion* **2**^{a}

Carbonyl compound **3**	*Hydroxy ester* **5 (%)**	*Conjugated ester* **6 (%)**	*Hydroxy ketene acetal* **7 (%)**	*Carbonyl compound* **3**	*Hydroxy ester* **5 (%)**	*Conjugated ester* **6 (%)**
PhCHO **3a**	72	76 (E)	81^b	 **3f**	81	77
 **3b**	79	83 (E)		 **3g**		72 (E)
iPrCHO **3c**	72		72	 **3h**	79 (70/30)	74
tBuCHO **3d**	83		79			
 **3e**	79	84 (80/20)		 **3i**	73	83 (70/30)

a) Reported yield of chromatographed products **5** and **6**; in brackets : the isomeric ratio, see ref 13 for experimental conditions.
b) Presence of **6a** (15%).

For example, the condensation of lithio acetal **9a** with benzaldehyde and β-ionone provides an access to hydroxy esters **10** and conjugated esters **11**.



In agreement with Schlosser and coll^2 the thermic stability of lithio ketene acetal **2** is to be noted owing to the presence of a metal atom and an alcoxy group in a trans relationship, reported to give an easy elimination of metal alkoxide at temperatures ≲ -78°C.^{14}

REFERENCES AND NOTES

1 McElvain, S.M.; Magnani, A.; *J. Am. Chem. Soc.* **1937**, *60*, 2266-2269.

2 Wei, H-X.; Schlosser, M.; *Tetrahedron Lett.* **1996**, *37*, 2771-2772.

3 a) Hiouni A., Diplome d'Etudes Approfondies, Rouen, **1992**.

b) Hiouni, A.; Duhamel, L.; Duhamel, P.; Congrès National de la Société Française de Chimie, Lyon, 28 sept. **1994**.

c) Hiouni, A.; Duhamel, L.; Duhamel, P.; Anglo-Norman Organic Chemistry Colloquium III, Deauville, 15-17 may **1995**.

4 Sugahara, T.; Komatsu, Y.; Takano, S.; *J. Chem. Soc. Chem. Commun.*, **1984**, 214-215.

5 Mousseron-Canet, M.; Mousseron, M.; Legendre, P.; *Bull. Soc. Chim. Fr.* **1961**, 1509-1512.

6 Young, W.G.; Andrews, L.J.; Cristol S.J.; *J. Am. Chem. Soc.* **1944**, *66*, 520-524.

7 Breusch, F.L.; Baykut, F.; *Chem. Ber.* **1957**, *90*, 526-531.

8 Meyers, A.I.; Temple, D.L., Nolen, R.L.; Mihelich , E.D.; *J. Org. Chem.* **1974**, *39*, 2778-2783.

9 Kuwajima, I.; Minami, N.; Sato, T.; *Tetrahedron Lett.* **1976**, *26*, 2253-2256.

10 Wittig, G.; Schöllkopf, U.; *Chem. Ber.* **1954**, *87*, 1318-1330.

11 Bottin-Strzalko, T.; *Tetrahedron* **1973**, *29*, 4199-4204.

12 Tagushi, H.; Shimoji, K.; Yamamoto, H., Nozaki, H. *Bull. Chem. Soc. Jpn.* **1974**, *47*, 2529-2531.

13 *Typical working procedure*: To 2-bromo-1,1-diethoxyethylene **1** (0.2 g, 1,06 mmol) in ether (4.2 ml) was added in 10 min at -78°C under argon *tertio*-butyl lithium (1.7M in pentane, 1.09 ml, 1.85 mmol). After stirring for 90 min, carbonyl compound **3** (0.82 mmol) in ether (2ml) was added and warmed to -30°C (for aldehydes) or -15°C (for ketones) for 75 min. *Esters* **5** *and* **6**: At -60°C, aqueous 10% Na_2CO_3 (4ml) (or HCl 1M, 4ml) was added and the mixture was stirred for 30 min at RT. Esters **5** or **6** were obtained after classical work-up and chromatography on silicagel: hydroxy esters **5**: petroleum ether/ether:90/10; ethylenic esters **6**: petroleum ether/ether:97/3. *Hydroxy ketene acetals* **7**: At -78°C, *tertio*-butyl bromide (0.095 ml, 0.82 mmol) was added. After stirring for 15 min, the mixture was taken up with a syringe and centrifuged for elimination of the lithium salts, ketene acetals **7** were obtained after evaporating the solvents: **7c** ^1H RMN (C_6D_6): 4.46 (dd,1H,J=7.2andJ=7.6); 3.80 (q,2H,J=7.2); 3.72(d,1H,J=7.2); 3.41 (q,2H,J=7.2); 1.90 (m,1H); 1.60(m,1H ex.D_2O); 0.90(2t,6H,J=7.2); 0.85 (2d,6H,J=6.1).

14 *a)* Viehe, H.G. *Chemistry of Acetylene*; Dekker M.: New York, 1969; pp. 140-142.

b) Lau, K.S.Y.; Schlosser, M.; *J. Org. Chem.* **1978**, *43*, 1595-1598.

c) Ficini, J.; Khan, P.; Falou, S.; Touzin, A.M.; *Tetrahedron Lett.* **1979**, 67-70.

d) Smithers, H.; *J. Org. Chem.* **1983**, *48*, 2095-2097. In this work, a vinyllithium anion, with the lithium atom and the methoxy group in trans configuration, has been trapped.

e) Duhamel, L.; Tombret, F.; Mollier, Y.; J. Org. Met. Chem. **1985**, 280, 1-16.

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